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High altitude montane wetland vegetation classification of the Eastern Free State, South Africa ☆

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ABSTRACT

Wetlands occur where biotic and abiotic conditions combine to create unique habitats and plant assemblages. These systems have anaerobic or hydric soil resulting from waterlogging and are found across all nine biomes in South Africa. Wetlands can thus be regarded as hosting azonal vegetation. On Platberg, the freshwater wetlands are embedded within the Grassland Biome forming distinct units. Platberg wetlands were surveyed and described to explain and document vegetation of this inselberg. Additional aims were to elucidate Afro-montane floristic links with the Drakensberg Alpine Centre, and provide data for conservation management. The study site is located in the Eastern Free State, South Africa, on edge of the Great Escarpment. It is one of an archipelago of more than 20 inselbergs stretching north from the Drakensberg. A total of 51 sample plots (30 m^2) were located in a randomly stratified manner within the wetland units to include all variations in the vegetation. The data was analysed using the TWINSPAN classification algorithm, refined by Braun-Blanquet procedures. The analysis showed the wetlands divided into five communities, six sub-communities and six variants. The wetland communities had an average of 13.56 species per relevé, ranging from 7 to 29 species per sample plot. Numerous floristic links with the Drakensberg Alpine Centre, the Cape Floristic Region and the Grassland biome were found. Platberg shows vegetation and hydrogeological affinity with low altitude freshwater and the high altitude Lesotho Mires of the Drakensberg Alpine Centre. A list of high altitude wetland species was compiled.

1. Introduction

Wetlands have traditionally been regarded as wastelands and as a result large systems have been drained, mined, or modified for agricultural, silviculture, and other related development purposes (Grundling et al., 1998; Stern, 1997). As more research on wetlands has been conducted people started realising the significance of these sensitive ecosystems. Today wetland systems are regarded as irreplaceable components of the environment that is highly threatened due to a variety of human activities (Ewart-Smith et al., 2006). Freshwater wetlands are one of the most productive ecosystems in the world exhibiting distinct differences in their hydrology, plant communities, species richness, ecosystem functioning, and soil types (Reddy and DeLaune, 2008).

The word wetland is a generic term (Janecke et al., 2003), which does not allow for an adequate description of the complex differences in types of wetlands, the processes that formed them or to effectively quantify the vegetation. The presence of water, whether it is flowing or stagnant, salty or fresh, seasonal or permanent, is the primary factor in forming habitats suitable for wetlands and the associated vegetation (Mucina and Rutherford, 2006).

There is no universally acceptable definition for wetlands (Davis and Brock, 2008; Ewart-Smith et al., 2006). For South Africa, Collins (2005) defines wetlands as areas where surface water collects or underground water discharges to the surface making the area wet for extended periods of time. Ewart-Smith et al. (2006) and Collins (2005) extend the term wetlands to aquatic systems, which can be permanently or temporarily saturated. Temporarily saturated wetlands are regarded as 'transitional' wetlands.

For South Africa, the Department of Water Affairs and Forestry (DWAF, 2003) has provided a definition of wetlands in the South African Water Act to help researchers and other users in their work. The Act's definition incorporates three important concepts used to define a piece of land as a wetland namely hydrology, soil wetness, and hydrophilic vegetation (Collins, 2005). Although the vegetation component is recognised, the abiotic component (landform, soil and substrate)

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is used as the primary indicator in their wetland classification system for South Africa (Ewart-Smith et al., 2006).

Research on wetland vegetation in South Africa has been conducted for many years but these attempts have only recently been combined in a comprehensive phytosociological based classification system with the publication of "The Vegetation of South Africa, Lesotho and Swaziland" by Mucina and Rutherford (2006). In their publication Mucina and Rutherford (2006) describe wetlands present in all eight biomes according to their vegetation component. Mucina and Rutherford (2006) use the term *azonal* vegetation sensu stricto, where it is understood that plant community structure and floristic composition are the result of special substrates (soil or bedrock), or hydrogeological conditions (waterlogging) which exert overriding influence on floristic composition, structure and dynamics over microclimate (Mucina and Rutherford, 2006) as in wetlands. This is especially true for the Mountain wetlands occurring on high altitude areas such as Platberg in the Eastern Free State.

Platberg as an inselberg in the Eastern Free State, South Africa (Fig. 1), represents a refuge for indigenous plants and animals (Mutke et al., 2001, Burke, 2001). It has an altitude ranging from 1900 m (footslopes) to the highest point of 2394.4 m (Chief Directorate: Survey and Mapping, 2000) (Fig. 2). The unique, high altitude conditions found above 2000 m, lead to high levels of endemism in organisms; plants, animals and bryophytes (Hillard and Burtt, 1987; Van Wyk and Smith, 2001; Carbutt and Edwards, 2006; Mucina and Rutherford, 2006). This is due to the compression of climatic life zones over a short topological distance that makes mountains hot spots for biological diversity (Körner, 2003). Mountains may be regarded as analogous with an archipelago of islands in an 'ocean' of low-level vegetation types which act as an isolation factor (Taylor, 1996; MacArthur and Wilson, 2001).

Mountain wetlands as a special sub-division of freshwater wetlands form an archipelago of isolated patches embedded in the Grassland Biome (Mucina and Rutherford, 2006), most of which are found above 2500 m in Lesotho, and the South African Drakensberg. For Platberg, the wetlands comprise drainage-line grassland and forblands, and represent an outlier of the AZf4 Drakensberg Wetlands (Mucina and Rutherford, 2006) while also sharing some floristic links and similarity of hydrogeological characteristics with the AZf 5 Lesotho Mires.

The concept of zonality and its corollary, azonality to describe and map wetlands, (Mucina and Rutherford, 2006), particularly for small wetland habitats is directly applicable for Platberg, with its relatively limited size (3000 ha), and numerous, small wetland habitats.

This paper aims at:

i Describing the floristic composition of the different wetland communities of the study area.
ii Classifying them into different hydrogeomorphic categories based on the degree to which the dominant plant species are associated with wetlands.
iii Elucidating Afro-montane floristic links with the Drakensberg Alpine Centre and provide data for conservation management plans.
iv Providing a baseline plant species list for this area, as no definitive list of high altitude wetland plants exists on inselbergs.

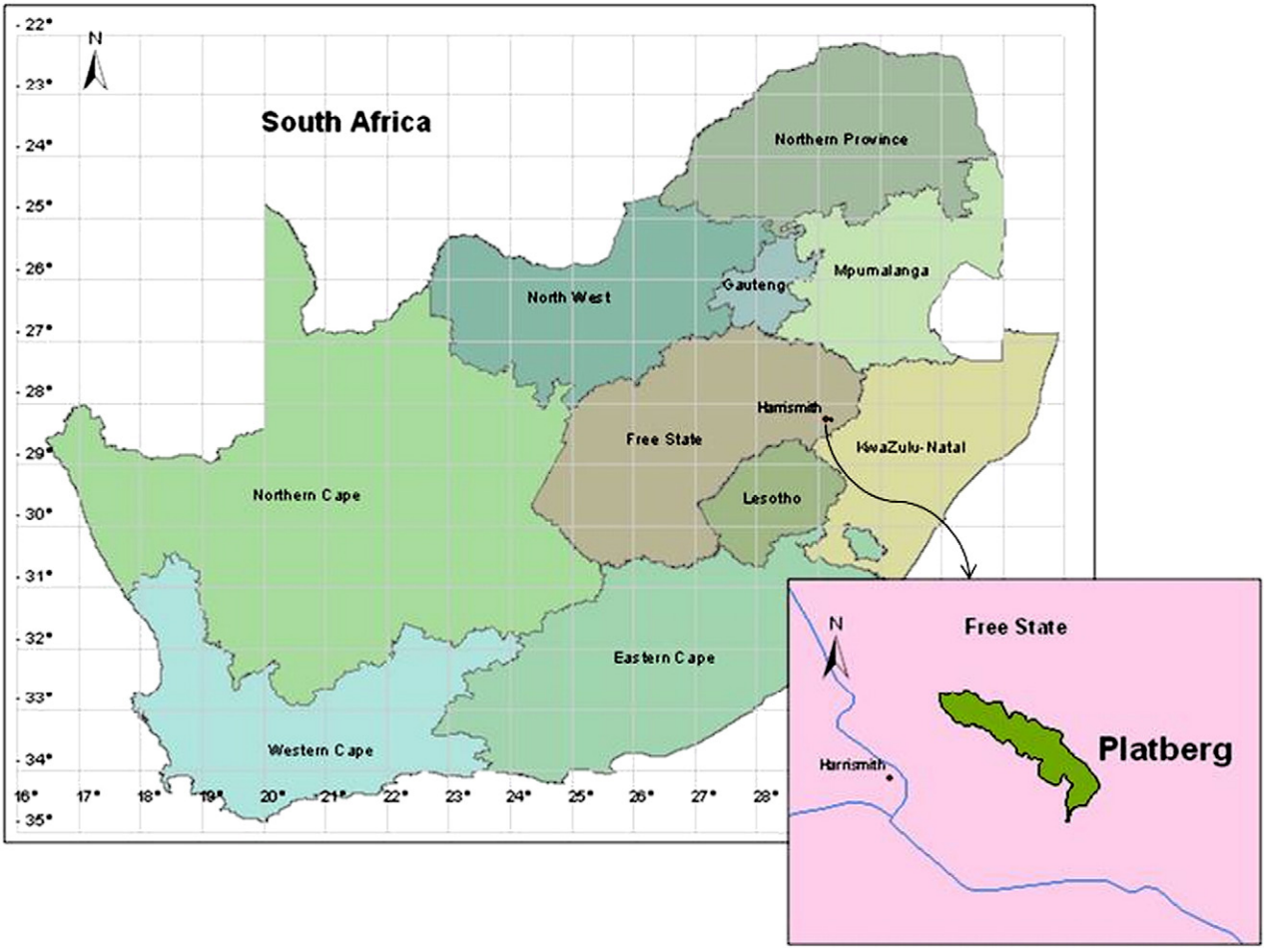


Fig. 1. Location of study area.

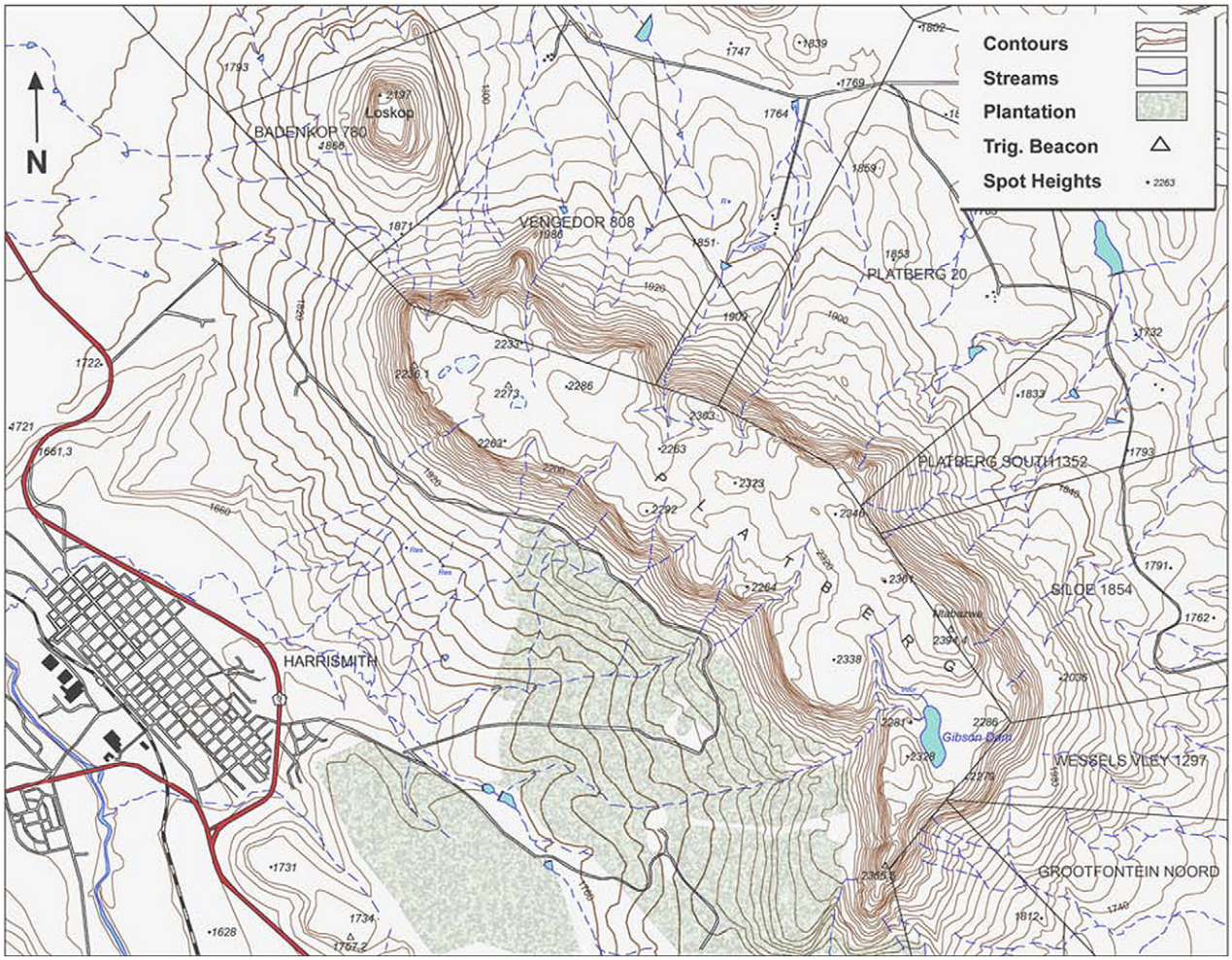


Fig. 2. Topography of the study area.
(Adapted from Chief Directorate: Survey and Mapping, 2000).

2. Study area: location, physical and biotic aspects

Platberg is approximately 3000 ha in size and overshadows the town of Harrismith (latitude S 29° 10′ and longitude E 28° 16′) on the N3 highway between Johannesburg and Durban (Fig. 1).

2.1. Vegetation

The vegetation description presented by Mucina and Rutherford (2006) shows Platberg embedded in the Eastern Free State Sandy Grassland (Gm 4). However, Platberg, as an inselberg with a plateau over 2200 m, is designated as part of the Drakensberg Grassland Bioregion (Mucina and Rutherford, 2006).

2.2. Geology

Platberg is capped by Jurassic dolerite and lava, with lower strata consisting of layers of the Karoo Supergroup, which, for the Drakensberg range, lies immediately below the volcanics of the Drakensberg Formation, the youngest unit of the Stormberg Group (Brand et al., 2009).

2.3. Topography and soil

The summit plateau is composed of a mix of igneous rock–amygdaloidal basaltic lava and dolerite (Brand, 2007). The soil are generally shallow (10–200 mm Brand et al., 2008) occurring on rock sheets or rocky ridges. However, some of the wetland soil have accumulated to a depth of 300 to 500 mm. Soil has even proportions of course sand, fine sand, clay, silt, with moderate to high organic matter content. The main land type (Land Type Survey Staff, 1991) is Ea (clay vertic, melanic or red diagnostic horizons — Soil Classification Working Group (1991), Smit et al., 1993; Mucina and Rutherford, 2006) with a clay content of 8% to 60% dependant on soil series (Macvicar et al., 1991). A more detailed description of topography and soil has been presented by Brand (2007), and Brand et al. (2008, 2009).

2.4. Climate

Rainfall is seasonally (mean annual precipitation: 739 mm for the Drakensberg, with Platberg's eastern summit receiving up to 1200 mm — SA Weather Services, 2007) with most rain falling between November to March. Temperature regime is cold-temperature (June and July the coldest months) with a mean annual temperature of 9.6 °C, ranging from −2 °C to 24 °C for the hottest month of January (anecdotal record of highest temperature recorded on Platberg was 55.6 °C during the survey period). The daily mean relative humidity for the most humid month March varies between 68% and 72%, and the daily minimum relative humidity for July and August, between 32% and 38% (Van Zinderen Bakker, 1973; Schulze, 1997; Mucina and Rutherford, 2006; South African Weather Services, 2007). Detailed climate diagrammes are presented in Brand (2007), Brand et al. (2008, 2009).

3. Materials and methods

3.1. Vegetation surveys

As part of a larger study of the vegetation of Platberg a total of 51 sample plots were placed within the wetland sections of Platberg and used for this study. Plot sizes were fixed at 6 m × 5 m to give a total surface area of 30 m^2 (Westhoff and Van der Maarel, 1980; Whittaker, 1980; Du Preez and Bredenkamp, 1991; Du Preez, 1991; Malan, 1998). Selection and sampling of wetlands were done where a visible difference could be seen between surrounding grassland and wetland vegetation. Sample plots were located in a randomly stratified manner within these units to ensure that all variations in the vegetation were considered and sampled (Barbour et al., 1987). In all sample plots each species was recorded and canopy cover estimated using the modified Braun-Blanquet cover-abundance scale (Mueller-Dombois and Ellenberg, 1974; Whittaker, 1980; Kent and Coker, 1992). Unknown specimens were identified at the Geo Potts Herbarium, University of the Free State and the National Herbarium of the South African National Biodiversity Institute (SANBI) in Pretoria. All floristic material currently resides at the Geo Potts Herbarium. Taxon names conform to those of Germishuizen et al. (2006). Fieldwork commenced in February 2005 and was completed in 2007.

Environmental data collected included latitude & longitude, drainage according to Tiner (1999), soil depth and notes on management and utilisation. Soil depths were measured with a probe graded for 5 cm intervals to a maximum of 30 cm. Soil saturation, colour, and inundation, were noted using visual observations as described by the Federal Interagency Committee for Wetland Delineation (1989), Tiner (1999), and Collins (2005).

3.2. Vegetation data analysis

Habitat as well as floristic data was captured using TURBOVEG (Hennekens, 1996). The data was exported to JUICE (Tichý, 2002) from where a first approximation of the plant communities was derived using the modified TWINSPAN (two-way Indicator Species Analysis) classification algorithm proposed by Roleček et al. (2009). Pseudospecies cut levels were set at 0–2–5–10–20. All non-diagnostic species with low constancy at the bottom of the table were also discarded. A DCA ordination using the PC-ORD 5.20 package (McCune and Mefford, 2006) was applied to the floristic data to determine the relationship between the various vegetation units and environmental gradients. The stepwise ordination approach as described by Mucina and Van Tongeren (1989) was followed to manage the heterogeneity of the data set.

3.3. Classification of wetland species

The degree to which certain plant species are associated with wetlands (wetland indicator status), was used to classify them into the following categories (Cronk and Fennessy, 2001; Tiner, 1999; Federal Interagency Committee for Wetland Delineation, 1989):

- *Obligate Wetland* (*OBL*). Almost always occurs in wetlands (estimated probability >99%) under natural conditions
- *Facultative Wetland* (*FACW*). Usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in uplands
- *Facultative* (*FAC*). Equally likely to occur in wetlands (estimated probability 34%–66%), or uplands
- *Facultative Upland* (*FACU*). Usually occur outside wetlands (estimated probability 67%–99%), but occasionally found in wetlands (estimated probability 1%–33%)
- *Obligate Upland* (*UPL*). Occur almost always (estimated probability >99%) outside wetlands under natural conditions

The presence of hydrophilic vegetation in the different plant communities identified was determined using the dominance ratio method (Collins, 2005; Cronk and Fennessy, 2001). The wetland community types were also defined using the "association concept" which states that floristic composition resulting from certain environmental conditions (soil and water amount/depth) display relatively uniform physiognomy (Collins, 2005; Keddy, 2007). The term "dominant species" used in the descriptions refers to those species with the highest percentage of canopy cover (Daemane et al., 2010). No attempt was made to fix syntaxa names formally, as this is normally avoided in detailed local studies in South Africa (Coetzee, 1983)

4. Results

4.1. Vegetation classification

The analysis identified 13 different plant communities that can be divided into five major communities, six sub communities, and six variants. The phytosociological classification of the wetland communities is presented in Table 1 and is as follows:

1 *Helictotrichon turgidulum–Dierama dracomontanum* community.
2. *Bulbostylis schoenoides–Carpha filifolia* community.
2.1 *Xyris capensis–Eriocaulon dregeana* sub-community.
2.2 *Gerbera piloselloides–Dierama dracomontanum* sub-community.
3 *Fingerhuthia sesleriiformis–Andropogon appendiculatus* community.
3.1 *Festuca caprina–Pennisetum thunbergii* sub-community.
3.2 *Helictotrichon longifolium–Pennisetum sphacelatum* sub-community.
3.2.1 *Isolepis costata* variant.
3.2.2 *Pennisetum sphacelatum* variant.
3.2.3 *Senecio isatideus* variant.
3.2.4 *Gunnera perpensa* variant.
3.2.5 *Aristida junciformis* variant.
3.2.6 *Agrostis eriantha* variant.
4 *Andropogon appendiculatus–Ficinia stolonifera* community.
5 *Juncus oxycarpus–Eliocaris dregeana* community.
5.1 *Eleocharis dregeana–Denekia capensis* sub-community.
5.2 *Eliocaris dregeana–Phragmites australis* sub-community.

4.2. Description of the plant communities

The wetlands are located on the summit plateau embedded in open grassland. Scattered fynbos shrubs grow as components of the wetlands, on rocky outcrops (Table 1, species group E, sub-community 2.2). Little disturbance from cattle grazing is evident with no records of ploughing or crop cultivation on Platberg's plateau (Koeglenberg, 2006; Gobles, 2006). There are some scattered *Pinus patula* trees, growing as solitary 'escapees' from plantations at the lower slopes.

The wetland vegetation is characterised by sedges, juncales, grasses, grass-like geophytes, and forbs. All mention to species groups refers to Table 1.

1 *Helictotrichon turgidulum–Dierama dracomontanum* community.
The *Helictotrichon turgidulum–Dierama dracomontanum* community occurs on flat-lying terrain on the summit area on the cool southern aspect of Platberg, at an altitude of 2306 m on shallow, naturally occurring depressions within the larger grassland. Aspect is west or south in full sun. No rock exposure was found. The community is seasonally inundated, with soil depths greater than 300 mm. No erosion or trampling was seen evident even though wildlife paths transect the community. Rodent runways, burrows and nests plus dung were also seen scattered within the wetland vegetation.
The diagnostic species for this community include the perennial, tall grass *H. turgidulum*, the geophytes *Hesperantha coccinea*, *Tritonia linneata* and the forb *Epilobium salignum* (species group A).

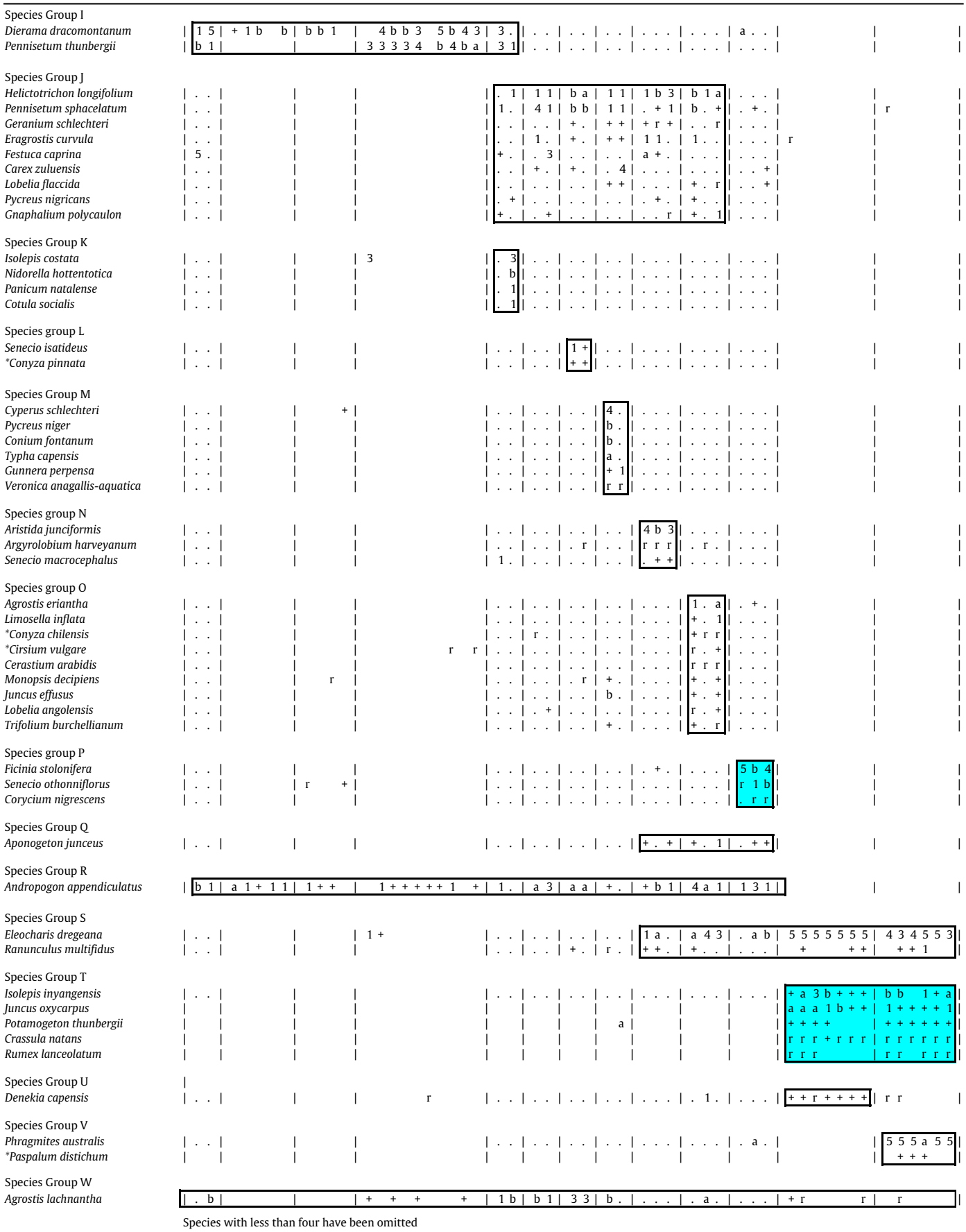
Table 1
Wetland communities on the Platberg plateau, Eastern Free State, South Africa.

Relevé number	172	175	434	433	432	435	436	437	438	439	440	459	458	460	455	456		457	454	461	462	198	174	215	219	222	229	246	263	209	211	210	213	216	214	282	163	164	447	448	450	446	451	452	453	441	442	443	444	445	449
Free State Database number	37376	37379	37696	37695	37694	37697	37698	37699	37700	37701	37702	37721	37720	37722	37717	37718		37719	37716	37723	37724	37402	37378	37419	37423	37426	37433	37450	37467	37413	37415	37414	37417	37420	37418	37486	37367	37368	37709	37710	37712	37708	37713	37714	37715	37703	37704	37705	37706	37707	37711
Number of species per relevé	11	11	09	10	12	15	10	14	17	25	27	17	16	16	16	14		14	15	11	18	13	13	11	12	19	13	20	17	15	21	13	29	11	26	10	09	12	09	13	08	07	09	09	08	09	11	08	09	07	08
Community	1		2									3																								4			5												
Sub-community			2.1					2.2				3.1										3.2																	5.1							5.2					
Variant																						3.2.1		3.2.2		3.2.3		3.2.4		3.2.5			3.2.6																		
Species Group A																																																			
Helictotrichon turgidulum	b	b																				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Hesperantha coccinea	1	a																				1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Tritonia lineata	1	1																				.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Epilobium salignum	1	r																				.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Species Group B																																																			
Koeleria capensis	.	b	r		r	1																.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Species Group C																																																			
Eriocaulon dregei			b	3	3	a	b	1	+		+			+			+				+																														
Carpha filifolia			a	4	a	b	3	4	5	4	4																																								
Bulbostylis schoenoides	.	.	1	b	1		b	1	1	1	b											.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.													
Athrixia fontana			r	r	+	+	+	+		+	+																																								
Urtricularia livida				r	+		r		r	+	r																																								
Drosera collinsiae				+		+	+	r	r	r	r																																								
Helichrysum auriceps					r	+	r	r	r	r																																									
Species Group D																																																			
Xyris capensis	.	.	+	1	a	+	+		r	r												.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.		a											
Juncus dregeanus	.	.		+	+	+				+										r		.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.													
Rhodohypoxis milloides			r			r				r																																									
Species Group E																																																			
Gerbera piloselloides	.	.						+	+	+	+											.	.	.	.	r	.	.	.	.	+	.	.	.	.	.	1	.													
Cliffortia nitidula								r		+	1																																								
Pentaschistis natalensis	.	.							+	+												.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.		r			+		+						
Cliffortia spathulata									r	r	+																																								
Erica alopecurus									r	r	+																																								
Sebaea exigua	.	.				r				r	r											.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.													
Senecio seminivens						+				r	+																																								
Species Group F																																																			
Hesperantha baurii	.	.						r		r	r	+	+	r	+	r	r	+	r	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.													
Setaria sphacelata									r	+	+	+	+		1			r	+		+																														
Species Group G																																																			
Epilobium capense	.	.										r	r	r	r	r	r	r	r		r	+	.	+	+	+	+	.	+	+	r	.	+	+	.	.	.	.													
Fingerhuthia sesleriiformis	.	.				1			b		+	b	+	a	1				a	b	+	1	.	.	.	b	.	.	.	b	a	1	.	.	.	.	.	.													
Geranium multisectum	.	.												r	r	r	r					.	+	+	1	+	1	.	.	.	.	.	+	.	.	.	.	.													
Bromus firmior	+	1																			+	.	1	.	.	.	.	.	.	1	.	.	.	+	+	.	.	.													
Cynoglossum hispidum	.	.												+	r		r				r	.	3	+	.	.	.	.	.	.	.	.	+	r	+	.	.	.													
Species Group H																																																			
Festuca caprina												1	b	a	3	+	a	+	3	+	3																														
Isolepis inyangensis								+				+	+	+	+	+	+	r	+	+	+																														
Zaluzanskya ovata													+	+	+	+		+	+	+	+																														
Ascolepis capensis												+	+	+	r		+				+																														
Senecio retrorus												+	+	r					1	r																															
Hypoxis acuminata													r		+	+				1	+																														
Centella coriacea												+		+		+	r				r																		+	+		+									+
Cyrtanthus breviflora											+	+			r	r																																			
Pycreus macranthus											+	+						+	+																								+	+							
**Poa annua*															+	+		+																																	

(continued on next page)

The vegetation comprises a mix of grasses and grass-like species and geophytes. It is dominated by the grasses *H. turgidulum* (species group A), *A. appendiculatus* (species group R), *Pennisetum thunbergii* and the grasslike geophyte *D. dracomontanum* (species group I). The other prominent geophytes are *Hesperantha coccinea*, and *Tritonia linneata* (species group A). There is a significant but

Table 1 (*continued*)



Species with less than four have been omitted

limited presence of the grasses *Festuca caprina* (species group J), and *Agrostis lachnantha* (species group W). An average of 11 species per 30 m^2 was recorded for this community.

The cumulative cover of the dominant species at the different strata comprises 56% FACW and 30% FAC species.

2. *Bulbostylis schoenoides–Carpha filifolia* community

The *Bulbostylis schoenoides–Carpha filifolia* community lies adjacent to a bowl-like depression formed by rocky hills that drain into the series of wetlands. The sites have no rocks or slight rock exposure varying between 1% and 5%. Soil depths vary between 100 mm and greater than 300 mm and are moist to marshy. The community has a western aspect. Some wildlife paths traverse the wetlands with minor trampling and no erosion.

The presence of species group C is diagnostic for this community and includes the sedges *C. filifolia*, *B. schoenoides*, *Eriochepalus dregei*, the forbs *Helichrysum auriceps*, and *Athrixia fontana*, the small, insectivorous *Drosera collinsiae*, and the bladder wort *Urticularia livida.*

The vegetation is dominated by the sedges *C. filifolia* and *B. schoenoides* (species group D). The grass *A. appendiculatus* (species group R) and the geophyte *D. dracomontanum* (species group I) are co-dominants within this community with the sedge-like *Eriocaulon dregei* (species group C) locally prominent. Total species count is 128, which gives an average of 14.3 species per 30 m^2.

2.1 *Xyris capensis–Eriocaulon dregeana* sub-community

This sub-community is located between altitudes 2321 m and 2347 m in shallow depressions with rock exposure of 0%–25% with a mix of gravel and sand. Soil is moist to inundated; with depths varying from shallow 100 mm to 280 mm. The sub-community is on the east of Platberg with western and south-western aspects in full sun on the summit plateau. Wildlife paths cause some trampling but no erosion.

Species group D is diagnostic and includes the grass-like *Juncus dregeanus*, the forb *X. capensis* and the small, geophyte *Rhodohypoxis milloides*. The sub-community is dominated by the sedge-like *E. dregei* (species group C) and the sedge *C. filifolia* (species group E), and the sedge *B. schoenoides* (species group E), with the geophyte *D. dracomontanum* (species group I) together with the perennial grass *A. appendiculatus* (species group R) prominent. A total of 56 different plant species or 11.2 species per 30 m^2 was recorded.

The cumulative cover of the dominant species at the different strata comprises 98% FACW and 9% FAC species.

2.2 *Gerbera piloselloides–Dierama dracomontanum* sub-community.

The *Gerbera piloselloides–Dierama dracomontanum* sub-community is located in a slight depression, on a gently slope of 3°–8° with a western aspect 2291 m–2330 m. Rock exposure is <10% with scattered dolerite boulders <500 mm in size. Soil is gravel to fine, moist and seasonally inundated mostly deeper than 300 mm.

This sub-community is characterised by species group E (Table 1). Diagnostic species for the community are the low fynbos shrubs, *Cliffortia nitidula* and *C. spathulata*, and *Erica alopecurus*, the grass *Pentaschistis natalensis* and the forbs, *G. piloselloides*, *Senecio seminivens* and *Sebaea exigua*. The vegetation is dominated by the sedges *C. filifolia* (species group C) *B. schoenoides* (species group E), and the grass-like geophyte *Dierama dracomontana* (species group I). The perennial grass *Setaria sphacelata* and the rare geophyte, *Hesperantha baurii* (species group F) are present as single individuals. The presence of the shrubs *Cliffortia nitidula*, *C. spathulata* and *Erica alopecurus* (species group E) are restricted to the rocky outcrops in this sub-community. A total species count of 83 gives an average species count of 20.7 per 30 m^2.

The cumulative cover of the dominant species at the different strata comprises 80% FACW and 7% FAC species.

3 *Fingerhuthia sesleriiformis–Andropogon appendiculatus* community.

The *Fingerhuthia sesleriiformis–Andropogon appendiculatus* community has a southern aspect in the low-lying, shallow, terraced depressions on the east side of the summit plateau at altitudes varying between 2200 m and 2300 m. These wetlands are seasonally inundated, with small, perennial streams feeding and draining them. The terrain is without rocks or gravel, soil is fine grained and >300 mm deep. There is no erosion with some trampling by wildlife. Lined nests plus scattered faeces associated with these burrows would suggest the presence of rodents living in the wetland vegetation.

Species group G is diagnostic for this community and is composed of the perennial grasses *F. sesleriiformis* and *Bromus firmior*, and the forbs *Epilobium capensis*, *Geranium multisectum* and *Cynoglossum hispidum.*

The vegetation is dominated by the grasses *F. sesleriiformis* (species group G), and *A. appendiculatus* (species group R) with the latter mostly co-dominant in sub-community 3.1 and the former co-dominant in sub-community 3.2. The grass *Agrostis lachnantha* (species group W), the forbs *Epilobium capense*, *G. multisectum* and *Cynoglossum hispidum* (species group G), are also present. The total species count for this community is 377, which gives an average of 16.4 species per 30 m^2.

3.1. *Festuca caprina–Pennisetum thunbergii* sub-community

The *Festuca caprina–Pennisetum thunbergii* sub-community is located on all aspects of summit plateau in full sun at altitudes between 2200 m and 2300 m. There is no rockiness and the soil is fine grained (<1 mm). There is no erosion with moderate levels of trampling. The community is seasonally inundated with small streams, generally in shallow almost covered, culvert-like furrows entering or draining the depressions.

The grasses *Festuca caprina* and *Poa annua*, with the *hydrophylic* sedges *Isolepis inyangensis*, *Pycreus macranthus*, *Ascolepis capensis*, the forbs *Zaluzanskya* sp. *Centella coriacea*, *Senecio retrorsus* sp. and the geophyte *Cyrthanthus breviflorus* with *Hypoxis acuminata* (species group H) are diagnostic for this community.

The vegetation of this sub-community is dominated by the robust, perennial grasses *Pennisetum thunbergii* (species group I), and the geophyte *Dierama dracomontanum* (species group I) while the grasses *Fingerhuthia sesleriiforis* (species group G), and *Festuca caprina* (species group H) are prominent. The perennial grass *A. appendiculatus* (species group R), the sedges *Isolepis inyangensis*, *A. capensis* and the forb *Zaluzanskya species* (species group H) are locally present. The species count average is 17.1 for 30 m^2 plot.

The cumulative cover of the dominant species at the different strata comprises 85% FACW and 16% FAC species.

3.2. *Helictotrichon longifolium–Pennisetum sphacelatum* sub-community

The *Helictotrichon longifolium–Pennisetum sphacelatum* sub-community is located at altitudes between 2249 m and 2309 m, with moist to inundated soil on flat-lying, shallow depressions on all aspects of the summit plateau.

Species belonging to species group J are diagnostic for this sub-community and include the grasses *Helictotrichon longifolium*, *Pennisetum sphacelatum*, *Eragrostis curvula*, *Festuca caprina*, the sedges *Carex zuluensis* and *Pycreus nigricans*, and the forbs *Geranium schlecteri*, *Lobelia flaccida* and *Gnaphalium polycaulon.*

The vegetation is dominated by the perennial grasses *Helictotrichon longifolium*, *Pennisetum sphacelatum* (species group J), and *A. appendiculatus* (species group R). The grass *Agrostis lachnantha* (species group W) is locally prominent. Total species count is 223 which gives a species average of 15.9 per 30 m^2 relevé.

The cumulative cover of the dominant species at the different strata 32% FAC species.

This sub-community can be divided into six variants with a mosaic distribution pattern.

3.2.1. *Isolepis costata* variant

The plants of species group K are diagnostic for this variant and include the sedge *Isolepis costata*, the short grass *Panicum natalensis*,

and the forbs *Nidorella hottentotica*, and *Cotula socialis.*
The grasses *Pennisetum thunbergii* (species group I) and *Agrostis lachnantha* (species group W) dominates the vegetation. The rare, endemic, *hydrophylic* geophyte *Hesperantha coccinea* is present in one relevé (species group A). Average species count is 13 per 30 m^2

3.2.2. *Pennisetum sphacelatum* variant
The variant is typical of the sub-community and is characterised by the absence of species from species groups K, L, M, N, O and P.
The vegetation is dominated by the grasses *Agrostis lachnantha* (species group W), *A. appendiculatus* (species group R), *Pennisetum sphacelatum*, and *Helictotrichon longifolium* (species group J). The average species count is per 30 m^2 is 11.5 per plot.

3.2.3 *Senecio isatideus* variant
The variant is defined by two forbs from species group L, namely *Conyza pinnata* and *Senecio isatideus*.
The variant is dominated by the perennial grasses *Helictotrichon longifolium* and *Pennisetum sphacelatum* (species group J), *A. appendiculatus* (species group R), and *Agrostis lachnantha* (species group W). This variant is poorly developed and has limited distribution. Standing or oozing water fills seasonally inundated depressions. The average species count is 16 per 30 m^2.

3.2.4. *Gunnera perpensa* variant
The diagnostic species are from species group M and include the *hydrophylic* forbs *G. perpensa* and *Veronica anagallis-aquatica*, the sedges *Cyperus schlecteri* and *Pycreus niger*, with *Typha capensis* and the forb *Conium fontanum* present.
The grasses *Helictotrichon longifolium*, *Pennisetum sphacelatum* (species group J) are prominent throughout this variant with the the grass *Agrostis lachnantha* (species group W), the sedges *Juncus effusus* (species group O) *Carex zuluensis* (species group J), *X. capensis* (species group D),sedges, the forb *Lobelia flaccid*, and the hygrophyte *Potamogeton thunbergii* (species group T), and all present.
The average species number is 18.5 per 30 m^2.

3.1.1 *Agrostis eriantha* variant
Plants from species group O define the community and include the grass *Agrostis eriantha*, the sedges *J. effuses*, the invasive weeds *Conyza chilensis* and *Cirsium vulgare*, the forbs *Cerastium arabidis*, *Monopsis decipiens*, *Lobelia angolensis*, *Trifolium burchellianum* and the hygrophyte *Limosella inflata.*
The variant is dominated by the grasses *A. appendiculatus* (species group R), *Helictotrichon longifolium* (species group J), and the sedge *E. dregeana* (species group S). Other species present include the grass *Pennisetum shpacelatum* (species group J), the forbs *G. polycaulon* (species group J), *D. capensis* (species group U), and the hygrophilic *Aponogeton junceus* (species group Q). This variant is located on seasonally flooded depressions or open semi-permanent pans with an average of 18.7 per 30 m^2.

4. *Andropogon appendiculatus–Ficinia stolonifera* community.
The *Andropogon appendiculatus–Ficinia stolonifera* community is located on the flat summit plateau on the cool southern side of Platberg at altitudes from 2284 m to 2331 m. Gradients are <3° in seasonally inundated, shallow depressions with open water. Soil is waterlogged, black, with a high clay soil, and deeper than 300 mm. There is moderate trampling and no soil erosion. The variant occurs in full sun with no rockiness.
The species from Group P are diagnostic for this community and include the sedge *Ficinia stolonifera*, the orchid *Corycium nigrescens* and the forb *Senecio othonniflorus.*
This community is dominated by the sedge *Ficinia stolonifera* (species group P), with the tall red grass *A. appendiculatus* (species group R), the sedge *E. dregeana* (species group S), and the forb *Senecio othonniflorus* (species group P) prominent throughout this community. A total of 10.3 species per 30 m^2 plot was recorded.
The cumulative cover of the dominant species at the different strata comprises 9% FACW and 89% FAC species.

5. *Juncus oxycarpus–Eliocaris dregeana* community
The *Juncus oxycarpus–Eliocaris dregeana* community is located on the western side of Platberg on the summit basalt in full sun. Altitudes vary between 2283 m and 2300 m. This community is located on shallow; seasonally inundated playas and a permanent lake located in a rocky depression. Soil is waterlogged, black with high clay content, and deeper than 300 mm. No erosion is evident but moderate trampling from wildlife is present.
The diagnostic species for this community include the *hydrophylic* sedges, succulents and forbs *Isolepis inyangensis*, *J. oxycarpus*, *Crassula natans*, *Potamogeton thunbergii*, and *Rumex lanceolatus* (species group T).
The community is dominated by the sedges *E. dregeana* (species group S) and *Isolepis inyangensis* (species group T). The forb *Ranunculus multifidus* (species group S) is present but has a low cover abundance. An average of 8.85 species per 30 m^2 was recorded.

5.1 *Eleocharis dregeana–Denekia capensis* sub community
The *Eleocharis dregeana–Denekia capensis* sub community is located on the summit plateau, on all aspects in full sun. It has a slight incline <3° to the east, in shallow depressions, flooded by seasonal rains. Soil is waterlogged, black with high clay content and deeper than 300 mm. There is no erosion with moderate trampling. No rocks are visible.
The sub-community is characterised by a single species, the forb *D. capensis* (species group U).
The vegetation is dominated by the aquatic sedges *E. dregeana* (species group S), *J. oxycarpus* and *Isolepis inyangensis* (species group T) with the forb *D. capensis* (species group U), the aquatic succulent *C. natans*, and *Potamogeton thunbergii* (species group T) present. A total of is 9 species per 30 m^2 was recorded.
The cumulative cover of the dominant species at the different strata comprises 88% FACW and 7% OBL species.

5.2 *Eleocharis dregeana–Phragmites australis* sub community
The *Eleocharis dregeana–Phragmites australis* sub-community grows in the only naturally occurring, perennial open body of water on Platberg. It occurs in the west on the summit plateau in an oval, rocky basin. The water is >2 m deep with flat sheet rock outcrop in the west and south. Soil is waterlogged, black, and deeper than 300 mm. No erosion and moderate trampling are evident.
Species from species group V are diagnostic and include the grasses *P. australis* and *Paspalum distichum* reaching heights of between 2 m and 3 m.
The vegetation is dominated by the tall hydrophylic reed *P. australis* (species group V), and the aquatic sedges *E. dregeana* (species group S), and *Isolepis inyangensis* (species group T). Total species count is 52, which gives an average of 8.7 species per 30 m^2 sample plot.
The cumulative cover of the dominant species at the different strata comprises 15% FACW and 85% OBL species.

4.3. Wetland classification

The wetland indicator status (Tiner, 1999) and the wetland community type for each plant community are indicated in Table 2. Except for community 3.2 where the cumulative cover of the dominant hydrophilic vegetation comprises only 32%, the dominant plant species in all other communities are hydrophilic with cumulative cover ranging between 62% and 100%.

4.4. Ordination and environmental gradients

The distribution of the wetland communities on Platberg using a DCA along the first axis (eigen value 0.592) and second axis (eigen

Table 2
Classification of Platberg wetlands.

Community number and name	Wetland indicator status	Wetland community type
1 *Helictotrichon turgidulum–Dierama dracomontanum*	FAC	Wet meadow/shallow marsh
2.1 *Xyris capensis–Eriocaulon dregeana*	FACW	Shallow marsh
2.2 *Gerbera piloselloides–Dierama dracomontanum*	FACW	Shallow marsh
3.1 *Festuca caprina–Pennisetum thunbergii*	FACW	Shallow marsh
3.2 *Helictotrichon longifolium–Pennisetum sphacelatum*	FAC	Wet meadow
4 *Andropogon appendiculatus–Ficinia stolonifera*	FAC	Wet meadow
5.1 *Eleocharis dregeana–Denekia capensis*	FACW	Shallow marsh
5.2 *Eleocharis dregeana–Phragmites australis*	OBL	Aquatic

OBL = Obligate Wetland, FACW = Facultative Wetland, FAC = Facultative, FACU = Facultative Upland, UPL = Obligate Upland.

value 0.549) is shown in Fig. 3. Soil moisture and slope decrease (water depth increases from left to right) along axis 1, with open water *Phragmites* communities occurring in permanent, naturally occurring, deep-water wetland on the extreme right of axis 1. The environmental gradient along axis 2, is not so clear, and may be a combination of rockiness, increasing from bottom to top, soil texture changing from coarse, sandy at the bottom to fine grained, high clay content at the top, and disturbance increasing from bottom to top.

Communities 2 and 3.1 on the extreme left of the ordination diagramme shows seasonally inundated soil, on moderate slopes (3°–8°) with some rock cover in selected areas. Community 3 is mostly located on seasonally moist soil, but has specialist wetland grasses and grass-like geophytes in some of the variants (e.g. *F. sesleriiformis*, *Pennisetum thunbergii*, and *Dierama dracomontana*) that are typical wetlands, but are not indicated on Fig. 3. The hydrophytic communities 5.1 and 5.2 are located on the extreme right of the diagramme showing species composition characteristic of permanent standing and open water communities. Sampling plots showing disturbance are located towards and bottom of the ordination diagramme.

5. Discussion

5.1. Floristic affinities

A total of 188 species (Table 1) were recorded in the 51 sample plots, which included five alien (weeds) species (Appendix 1). The wetlands are not particularly species rich, with an average of 13.56 species per 30 m^2, ranging from 7 to 29 species per sample plot. This has also been found by Collins (2005) for other lower altitude wetlands in South Africa.

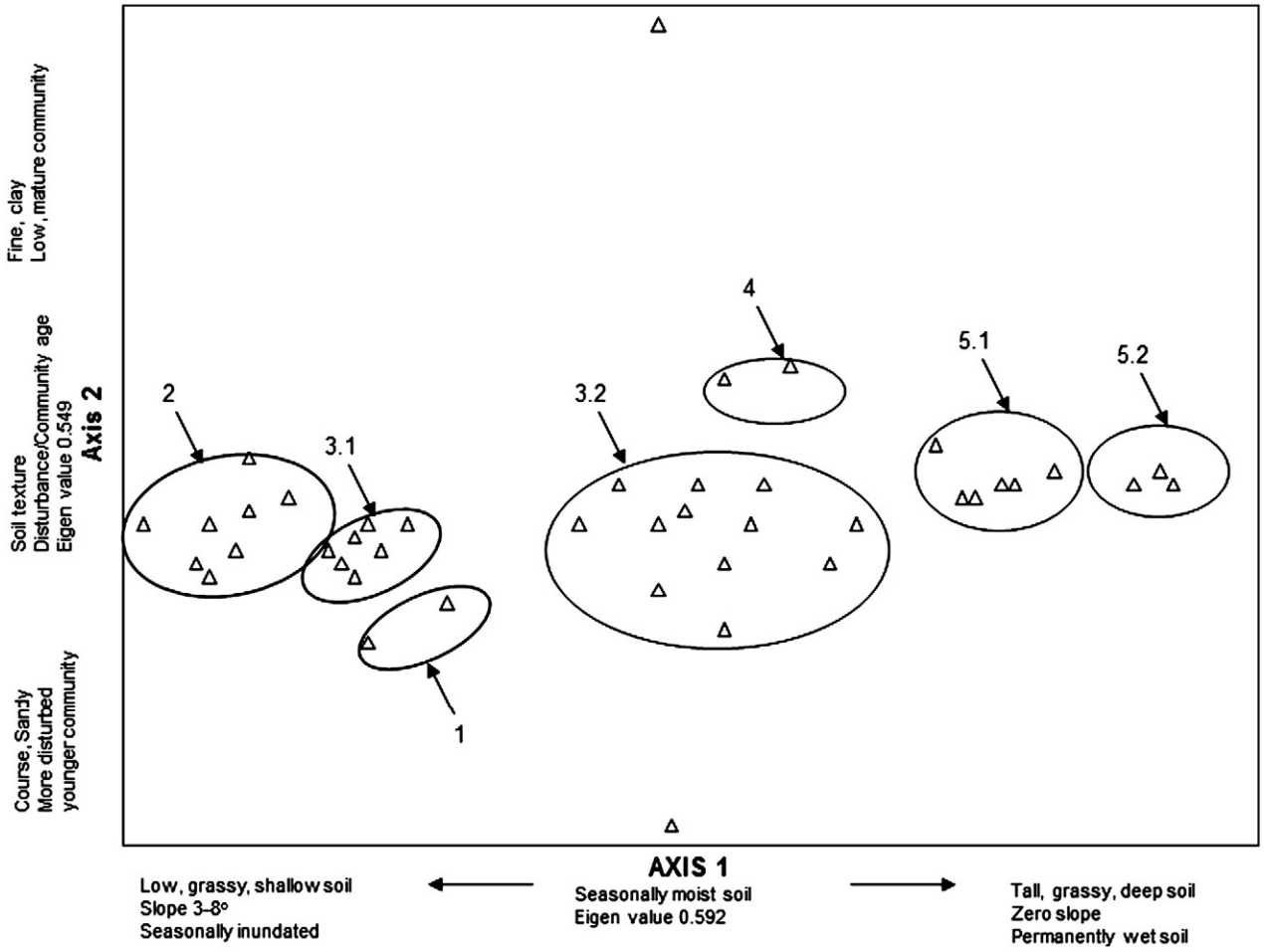


Fig. 3. Wetland ordination diagramme for Platberg.

Findings for Platberg wetlands indicate the majority are outliers of the AZf4 Drakensberg Wetlands (Mucina and Rutherford, 2006) but also include wetland communities with affinities linking both the lower altitude (ranging from 750 to 2000 m) AZf 3 Eastern Temperate Freshwater Wetlands, and the higher altitude (ranging from 2500 to 3400 m) AZf 5 Lesotho Mires (Mucina and Rutherford, 2006; Du Preez and Brown, 2011).

For the AZf 3 Eastern Temperate Freshwater Wetlands taxa show affinities with the wetlands identified in this study. Species occurring in both wetland systems include the forb *T. capensis*, graminoids, *Paspalum dilatatum*, *Pennisetum thunbergii*, *Scheonoplectus decipiens*, *Setaria sphacelata*, *A. appendiculatus*, the sedges *P. macranthus*, *P. nitidus*, *Xyris gerrardii*, the forbs *C. coriacea*, *L. flaccida*, *A. junceus*, *Potamogeton thunbergii* and the carnivorous forb *U. livida*.

Species present in the AZf 4 Drakensberg Wetlands as well as the Platberg wetlands include the graminoids: *A. capensis*, *C. filifolia*, *J. oxycarpus*, *Scirpus ficinioides*, *X. capensis*, *X. gerrardii*, the forbs *Epilobium salignum*, *Rumex lanceolatus*, *Limosella inflata*, *C. natans*, the sedge *Juncus dregeanus* and the carnivorous forb *U. livida.* Drainage-line shrubs of importance include *Cliffortia nitidula*, and *C. spathulata.* The wetland geophytic forb, *Dierama drakensbergensis* occurs on Platberg as a major component of the wetland vegetation and shows limited affinity with the AZf 4 Drakensberg Wetlands and the AZf 5 Lesotho Mires.

The presence of the insectivorous Facultative Wetland plants *D. collinsiae* and *U. livida* in the *Bulbostylis schoenoides–Carpha filifolia* community (community 2), indicates marshy moist, nitrogen poor soil (Hillard and Burtt, 1987; Pooley, 2003). This community has floristic, soil and hydrogeological similarities with AZf 5 Lesotho Mires described by Mucina and Rutherford (2006) and Du Preez and Brown (2011). The floristic affinities are shown by the presence of the graminoids *Isolepis costata*, *Scirpus ficinioides*, *Agrostis lachnantha*, *Juncus dregeanus*, *Koeleria capensis*, *Luzula africana*, *Pennisetum thunbergii*, the forbs *L. flaccida*, *Ranunculus multifidus*, *Ornithogalum paludosum*, *Oxalis obliquifolia*, *Rhodohypoxis spp.*, and carnivorous forbs, *U. livida*, aquatic forbs and succulents, *C. natans*, *A. junceus*, *Limosella* spp. in both wetland systems.

The status of community 2 as a wetland is substantiated by the presence of hydrophylic specialist plants, *U. livida* (species group C), and *Dierama dracomontanum* (species group I) (Pooley, 2003). The occurrence of these species as well as *E. dregei*, *R. milloides*, and the insectivorous plants *D. collinsiae* and *U. livida* in sub-community 2.1 are indicative of high altitude flora found in marshy, wet and moist soil on the Drakensberg (Hillard and Burtt, 1987; Pooley, 2003). This may reflect ecological and biogeographical links with the main Drakensberg as well as being a relictual population on Platberg.

Floristic links also exist between the *Bulbostylis schoenoides–Carpha filifolia* and the *Fingerhuthia sesleriiformis–Andropogon appendiculatus* communities (communities 2 and 3) and the *Bromus speciosus–Festuca elatior* playa community as well as the *Pennisetum thunbergii–Bothriochloa insculpta* seepage community, described by Bester (1998) occurring at altitudes of 1850–1950 m on the southern Drakensberg with similar temperatures, aspects and rainfall to Platberg. The *Gunnera perpensa* low altitude variant (community 3.2.4) occurs exclusively on Cave Sandstone of the Clarens Formation. This variant was located on the farms on the northern side of Platberg and shows significant trampling by cattle, and subsequent high erosion.

Although the *Isolepis costata* variant (community 3.2.1) is dominated by obligate wetland species *Agrostis lachnantha* and the facultative wetland species *Pennisetum thunbergii*, the prominence of the facultative species *A. appendiculatus*, *Cynoglossum hispidum*, and *Hesperantha coccinea* indicates the presence of both drier and wet areas. This community may be in the process of invasion by grassland plants due to the wetland drying resulting from the accumulation of sediment (*personal observation*). This variant is poorly developed and species-poor with a very narrow distribution and a high percentage of *hydrophylic* species.

Other floristic associations exist on the moist grasslands of Korannaberg in the Eastern Free State (Du Preez, 1991; Du Preez and Bredenkamp, 1991) as well as the wetlands described in Mpumalanga in the Sandy Highveld (Burgoyne et al., 2000). Dominant, diagnostic or defining species which emphasise these affinities include: the megagraminoid, *P. australis*, grasses *Pennisetum thunbergii*, *Festuca caprina*, *Miscanthus junceus*, *Agrostis lachnantha*, and the sedges *Eleocharis* spp., *Pycreus nitidus*, *Juncus exsertus*, *J. oxycarpus* and *J. dregeanus* and the sedge-like monocotoledon *E. dregei* and *X. capensis*, the forbs *Sebaea sedoides*, *G. multisectum*, *A. junceus*, *Epilobium silagnum*, *G. perpensa*, and *L. flaccida.*

Phytogeographic floristic links and affinities exist between the main Drakensberg (Killick, 1963, 1978a, 1978b; Hill, 1996; Bester, 1998; Carbutt and Edwards, 2004, 2006) as well the Korannaberg (Du Preez, 1991; Du Preez and Bredenkamp, 1991) due to the presence of the two Obligate Wetland plants *Potamogeton thunbergii* (species group T) and *A. junceus* (species group Q).

Platberg has no semi-aquatic vernal pool communities such as those found on the Korannaberg (Du Preez, 1991; Du Preez and Bredenkamp, 1991) or the bogs of the Sani Pass and Mont-aux-Sources areas (Killick, 1963, 1978a, 1978b). However, Platberg wetlands do show some species affinities with both vernal pools and bogs. These floristic affinities are seen in the *X. capensis–E. dregeana* community (community 2.1), the *Helictotrichon longifolium–Pennisetum sphacelatum* community (sub community 3.2), as well as the *E. dregeana–D. capensis* community (sub community 5.1) (Table 1). The bog and vernal pool common species include geophytic forbs *R. milloides*, the aquatic succulents and forbs *Limosella inflata*, *A. junceus*, *Potamogeton thunbergii*, *C. natans*, *C. coriacea* and the carnivorous plants *U. livida D. collinsiae.*

The vernal pool and bog vegetation types contain rare and endemic taxa, and even though rare and endemic species do not generally contribute significant cover/abundance values to community species numbers, they do contribute to biological heterogeneity across the Drakensberg Alpine Centre (DAC) and provide an explanation for ecological and evolutionary processes and changes of vegetation communities over time (Hill, 1996; Cowling and Lombard, 2002; Carbutt and Edwards, 2006).

The single stream that drains Platberg is fast flowing, and has incised a steep sided gorge, resulting in minimal alluvium build-up. It has dense stands of drainage-line shrubs from 1 to 6 m tall. In the upper reaches the mountain bamboo *Thamnocalamus tessellatus* grows in dense stands with the tall forb *Senecio isatideus*. The dominant shrub is *Leucosidea sericea*, with *Buddleja loricata* and *Cliffortia nitidula* growing below the summit plateau in the middle and lower reaches of the stream. The drainage-line shrubland was not sampled, as it was not regarded as part of the wetlands on the top of Platberg.

The availability of moisture, in many cases such as playas or pans with semi-permanent, or permanent open water, is the key factor that determines the common species shared by wetlands (Stock et al., 2004). According to this study various different species are associated with the different wetland types identified. The wetlands on Platberg have different degrees of soil moisture and depth indicating that other environmental factors could influence the floristic composition and structure of wetlands with varying degrees of moisture content.

5.2. Wetland indicator species

Plants growing in wetlands and water are called hydrophytes (Tiner, 1999) and are characterized by having developed the ability to grow in anaerobic soil. However, many of the plants found in wetlands also grow in terrestrial habitats (hydrophilic). These plants, although being more common in the latter, are also tolerant towards varying degrees of anoxic soil conditions (Tiner, 1999). The 'association concept' suggested by Keddy (2007), is a simple one using a particular set of plant (and where applicable animal) associations (Collins, 2005) together with hydrogeomorphic characteristics to classify wetlands.

An effort has been made for Platberg to compile a list of wetland plants to assist with the identification of high altitude wetlands using

criteria to define wetlands according to the three basic elements — hydrology, vegetation and soil (Federal Interagency Committee for Wetland Delineation, 1989). Assigning species to the different categories were done on a subjective basis using field observations, experience, plant community dominance and composition, and plant lists where available. The list was compiled from all species in the phytosociological table (Table 1). This list is presented in Appendix 1 and is not definitive, but must be seen as a first attempt to compile a list for high altitude, inselberg wetland indicator status plant species. As wetlands are azonal, the taxa listed may also occur in inland freshwater and other wetlands.

The five major wetland types as defined by Keddy (2007) namely Aquatic, Marsh, Mire, Swamp, and Wet meadow, were combined with the phytosociological descriptions and the dominant hydrophylic plant species to classify the wetlands. It was found that these categories were insufficient for the high altitude wetlands of Platberg. As a result two additional types where added namely Moist Grassland and Rocky Seep (Appendix 1).

5.3. Conservation value

According to Mucina and Rutherford (2006) the major treat to wetlands is changing the status of the wetland, by conversion from one form to another. This results in irrevocable loss of habitat and its biota. Due to the difficulty in accessing inselbergs in general, but Platberg in particular, the effects of some of the anthropogenic influences are reduced. There are only five alien (weeds) species (Appendix 1) with limited cover/abundance (Table 1).

For high altitude wetland conservation, the threat to genetic diversity (Anderson, 2001) as well as global warming are key considerations and highlights the importance of mountains and the associated inselbergs. The inclusion of Platberg would add another 3000 ha to the total under protection.

Mucina and Rutherford (2006), suggest that perhaps 50% of AZf4 Drakensberg Wetlands are conserved (well above the 24% suggested), however, for the AZf5 Lesotho Mires, only about 4% is statutorily conserved (24% is suggested for conservation), with most of this in the precincts of the uKhahlamba Drakensberg Park in South Africa. Additionally, Platberg has elements of the AZf3 Eastern Temperate Freshwater Wetlands, of with about 5% are statutorily conserved (conservation target is 24%), in two other Ramsar sites (Blesbokspruit Ramsar site No. 343 and Seekoeivlei No. 888) (Mucina and Rutherford, 2006). The wetlands on Platberg represent an amalgamation and repository of wetland habitats, making it an important area to conserve.

The threat posed by global warming to the world's alpine regions, including Africa, was predicted by Peters (1992) who indicated that as little as a 3 °C increase in temperature for 100 years, would be equivalent to a 500 m upward shift in altitudinal zones. For the Afromontane and Afroalpine biota, it would cause a significant reduction in the distribution of plants, and change their structure and composition, forcing some taxa to higher altitudes (Taylor, 1996), and in some cases i.e. Platberg which at its highest point is 2394.4 m, below the critical 2500 m altitude (Taylor, 1996), a significant loss of the taxa could occur with reduction and loss of habitat and vegetation structure.

6. Conclusion

As expected the plant communities are characterised by the dominance of hydrophylic grasses, sedges and forbs. Wetlands on Platberg occur mainly on the moderately flat summit plateau. The steep sides preclude the establishment of any sizable natural wetlands. Most species are associated with shallow, pan-like depressions and a few permanent open-water wetlands. Soil is either permanently waterlogged or inundated by seasonal rains.

The Wetlands on Platberg shows vegetation and hydrogeological characteristics of the AZf 4 Drakensberg Wetlands, low altitude AZf 3 Eastern Temperate Freshwater Wetlands, and the high altitude AZf 5 Lesotho Mires. The azonal vegetation types found on Platberg are discernable as discrete vegetation units, visibly different from the surrounding grassland. They show a range in classification from Aquatic, community 5.2 to wet meadow, community 2, with several transitional communities.

The Platberg wetlands have limited trampling, due to exclusion of cattle from Platberg's summit for more than 20 years. Grazing is now limited to low numbers of migratory wild herbivores. The low number of invasive exotic species indicates limited anthropogenic influence. The plant community structure and species numbers reflect more 'pristine' indigenous wetlands and biodiversity. No evidence of fire is apparent in the wetlands even though fire is normal for wetland areas, which could result in the long-term loss of habitat and species richness as the shallower depressions fill in with sediments and grassland species replace wetland species. This serves as a further motivation to protect and conserve the wetlands of Platberg.

The grass *Agrostis lachnantha* common in seepage areas (Van Oudtshoorn, 1999; Gibbs-Russell et al., 1991) and the hygrophyllous *A. appendiculatus* (shady to open high rainfall areas) are present in most of the communities identified with varying cover abundance values. Whereas the former grass is restricted to the wetland areas, the latter also occurs in the adjacent grassland areas (Brand, 2007; Brand et al., 2010) also indicating affinities between the grasslands and wetlands on Platberg.

The floristic collections plus the vegetation community analysis shows Platberg to be an important inselberg repository for biological diversity, with high species richness, and a variety of habitats and complex ecosystems. It is important that Platberg specifically, but inselbergs generally, be given attention as conservation sites with the development of a management plan by DETEA Free State, to carry out this task. Additionally, this study identifies that wetland vegetation on Platberg as and extension of the high altitude wetlands found it the KwaZulu-Natal Drakensberg.

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Appendix 1

The table is a list of wetland plants on Platberg grouped according to their wetland indicator status — the degree to which certain plant species are associated with wetlands, and is used to classify them into the following categories (Federal Interagency Committee for Wetland Delineation, 1989; Cronk and Fennessy, 2001; Tiner, 1999):

- *Obligate Wetland (OBL)*. Almost always occurs in wetlands (estimated probability >99%) under natural conditions
- *Facultative Wetland (FACW)*. Usually occurs in wetlands (estimated probability 67%–99%), but occasionally found in uplands
- *Facultative (FAC)*. Equally likely to occur in wetlands (estimated probability 34%–66%), or uplands
- *Facultative Upland (FACU)*. Usually occur outside wetlands (estimated probability 67%–99%), but occasionally found in wetlands (estimated probability 1%–33%)
- *Obligate Upland (UPL)*. Occur almost always (estimated probability >99%) outside wetlands under natural conditions.

Table 3
Categorisation of plants on Platberg according to wetland indicator status.

Species name and wetland indicator status	Family	Wetland community type
Obligate Wetland (OBL) Taxon		Aquatic playa or shallow wetland
Agrostis lachnantha Nees	Poaceae	Playa/stream banks
Aponogeton junceus Lehm. Ex Schltdl.	Aponogetonaceae	Playa/standing water
Eleocharis dregeana Steud.	Cyperaceae	Standing water
Eleocharis limosa (Schrad.) Schult.	Cyperaceae	Standing water
Gunnera perpensa L.	Gunneraceae	Playa/standing water
Isolepis costata A. Rich.	Cyperaceae	Standing water
Isolepis inyangensis Muasya & Goetgh.	Cyperaceae	Standing water
Limosella inflata Hilliard & B.L.Burtt	Scrophulariaceae	Playa/standing water
Phragmites australis (Cav.) Steud.	Poaceae	Playa/deep to shallow marsh
Potamogeton thunbergii Cham.& Schltdl.	Potamogetonaceae	Playa/standing water
Rumex lanceolatus Thunb.	Polygonaceae	Standing water
Rumex sagittatus Thunb.	Polygonaceae	Standing water
Typha capensis (Rohrb.) N.E.Br.	Typhaceae	Playa/standing water
Veronica anagallis-aquatica L.	Scrophulariaceae	Playa/standing water
Facultative Wetland (FACW) Taxon	Family	Wetland community type. Marsh/wet meadow
Agrostis eriantha Hack.	Poaceae	Wet meadow
Ascolepis capensis (Kunth) Ridl.	Cyperaceae	Wet meadow
Bromus firmior (Nees) Stapf	Poaceae	Wet meadow
Bulbostylis schoenoides (Kunth) C.B.Clarke	Cyperaceae	Wet meadow
Carpha filifolia Reid & T.H.Arnold	Cyperaceae	Wet meadow
Cirsium vulgare (Savi) Ten.[a]	Asteraceae	Wet meadow
Crassula natans Thunb.	Crassulaceae	Shallow marsh
Denekia capensis Thunb.	Asteraceae	Shallow marsh/wet meadow
Dierama dracomontanum Hilliard	Iridaceae	Deep/shallow marsh
Dierama trichorhizum (Baker) N.E.Br.	Iridaceae	Deep/shallow marsh
Drosera collinsiae N. E. Br. Ex Burtt Davy	Droseraceae	Shallow marsh/wet meadow
Epilobium capense Buchinger ex Hochst.	Onagraceae	Wet meadow
Epilobium salignum Hausskn.	Onagraceae	Wet meadow
Eriocaulon dregei Hochst.	Eriocaulaceae	Shallow marsh/wet meadow
Fingerhuthia sesleriiformis Nees	Poaceae	Shallow marsh/wet meadow
Gnaphalium polycaulon Pers.	Asteraceae	Wet meadow
Isolepis inyangensis Muasya & Goetgh.	Cyperaceae	Marsh/wet meadow
Juncus dregeanus Kunth	Juncaceae	Marsh/wet meadow
Juncus effusus L.	Juncaceae	Marsh/wet meadow
Juncus oxycarpus E.Mey. ex Kunth	Juncaceae	Marsh/wet meadow
Lobelia angolensis Engl. & Diels	Lobeliaceae	Wet meadow
Lobelia flaccida (C.Presl) A.DC.	Lobeliaceae	Wet meadow
Paspalum distichum L.[a]	Poaceae	Marsh/wet meadow
Pennisetum thunbergii Kunth	Poaceae	marsh/wet meadow
Pycreus macranthus (Boeck.) C. B. Clarke	Cyperaceae	Wet meadow
Pycreus nigricans (Steud.) C.B.Clarke	Cyperaceae	Wet meadow
Ranunculus baurii MacOwan	Ranunculaceae	Wet meadow
Rhodohypoxis baurii (Baker) Nel	Hypoxidaceae	Shallow marsh/wet meadow
Rhodohypoxis millfoides (Baker) Hillard & B.L. Burtt	Hypoxidaceae	Shallow marsh/wet meadow
Urtricularia livida E.May.	Lentibulariaceae	Shallow marsh/wet meadow
Xyris capensis Thunb.	Xyridaceae	Shallow marsh/wet meadow
Xyris gerrardii N.E.Br.	Xyridaceae	Shallow marsh/wet meadow
Facultative (FAC) Taxon	Family	Wetland community type. Wet meadow/moist grassland
Andropogon appendiculatus Nees	Poaceae	Wet meadow
Argyrolobium harveyanum Oliv.	Fabaceae	Moist grassland
Athrixia fontana MacOwan	Asteraceae	Wet meadow/rocky seep
Aristida junciformis Trin. & Rupr.	Poaceae	Wet meadow
Carex zuluensis C.B.Clarke	Cyperaceae	Wet meadow/moist grassland
Centella coriacea Nannf.	Apiaceae	Wet meadow
Cerastium arabidis E.Mey. ex Fenzl	Asteraceae	Wet meadow
Conium fontanum Hilliard & B.L.Burtt	Apiaceae	Wet meadow/rocky seep
Corycium nigrescens Sond.	Orchidaceae	Wet meadow/moist grassland
Cynoglossum hispidum Thunb.	Boraginaceae	Wet meadow/moist grassland
Cyperus schlechteri C.B.Clarke	Cyperaceae	Wet meadow/moist grassland
Cyrtanthus tuckii Baker	Amaryllidaceae	Wet meadow/moist grassland
Festuca caprina Nees	Poaceae	Wet meadow/moist grassland
Geranium multisectum N.E.Br.	Geraniaceae	Wet meadow/moist grassland
Geranium schlechteri R.Knuth	Geraniaceae	Wet meadow/moist grassland
Helichrysum auriceps Hilliard	Asteraceae	Wet meadow/moist grassland
Helictotrichon longifolium (Nees) Schweick	Poaceae	Wet meadow/moist grassland
Helictotrichon turgidulum (Stapf) Schweick.	Poaceae	Wet meadow/moist grassland
Hesperantha baurii Baker	Iridaceae	Wet meadow/moist grassland
Hesperantha coccinea (Backh. & Harv.) Goldblatt & J.C.Manning	Iridaceae	Wet meadow/moist grassland
Hypoxis acuminata Baker	Hypoxidaceae	Wet meadow/moist grassland
Koeleria capensis (Steud.) Nees	Poaceae	Wet meadow/moist grassland
Monopsis decipiens (Sond.) Thulin	Geraniaceae	Wet meadow/moist grassland
Pentaschistis natalensis Stapf	Poaceae	Wet meadow/moist grassland
Poa annua L.[a]	Poaceae	Wet meadow/moist grassland

Table 3 (*continued*)

Species name and wetland indicator status	Family	Wetland community type
Pycreus niger (Ruiz & Pav.) Cufod.	Cyperaceae	Wet meadow/moist grassland
Sebaea exigua (Oliv.) Schinz	Gentianaceae	Wet meadow
Senecio inornatus DC.	Asteraceae	Wet meadow
Senecio isatideus DC.	Asteraceae	Wet meadow
Senecio macrocephalus DC.	Asteraceae	Wet meadow
Senecio retrorsus DC	Asteraceae	Wet meadow
Trifolium burchellianum	Fabaceae	Wet meadow/moist grassland
Tritonia lineata (Salisb.) Ker Gawl.	Iridaceae	Wet meadow/moist grassland
Zaluzanskya ovata sp? (Benth.) Walp.	Scrophulariaceae	Wet meadow/moist grassland
Facultative Upland (FACU) Taxon	Family	Wetland community type. Moist grassland/rocky seeps
Cliffortia nitidula	Thymelaceae	Rocky seep
Cliffortia spathulata	Thymelaceae	Rocky seep
Conyza chilensis Spreng.[a]	Asteraceae	Moist grassland
Conyza pinnata (L.f.) Kuntze[a]	Asteraceae	Moist grassland
Cotula socialis Hilliard	Asteraceae	Moist grassland
Eragrostis curvula (Schrad.) Nees	Poaceae	Moist grassland
Erica alopecurus	Ericaceae	Rocky seep/Moist grassland
Ficinia stolonifera Boeck.	Cyperaceae	Rocky seep/Moist grassland
Gerbera piloselloides (L.) Cass.	Asteraceae	Moist grassland
Nidorella hottentotica DC.	Asteraceae	Moist grassland
Panicum natalense Hochst.	Poaceae	Moist grassland
Pennisetum sphacelatum (Nees) T.Durand & Schinz	Poaceae	Moist grassland
Senecio othonniflorus DC.	Asteraceae	Rocky seep/moist grassland
Senecio seminiveus J.M.Wood & M.S.Evans	Asteraceae	Rocky seep/moist grassland
Setaria sphacelata (Schumach.) Moss	Poaceae	Moist grassland

[a] Indicates alien species.

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