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The vegetation of grass lawn wetlands of floodplains and pans in semi-arid regions of South Africa: Description, classification and explanatory environmental factors

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ABSTRACT

This paper describes grass lawn wetlands, which are wetlands subjected to dynamic conditions, particularly highly fluctuating water tables that regularly drop deep below the ground surface. This occurs mostly in floodplain wetlands, as well as in wetlands in semi-arid regions or coastal plains. These wetlands are often dominated by short lawn grasses, particularly *Cynodon dactylon*, while other life forms, from taller tufted sedges to trees and shrubs, occur less frequently. A subset of data from a nationwide survey of wetland vegetation representing these grass lawn wetlands was selected for analysis using clustering and ordination techniques. Thirty-seven wetland communities are described and are further summarized into 13 community groups. Wetland communities on the coastal plains were associated with sandy soils whereas most of the other communities had a high clay fraction. Grass lawn wetlands are commonly found in a zone along the central, semi-arid part of the country and for this reason will likely play an important role in wetland monitoring in the long term.

1. Introduction

Wetlands are considered important habitats for the conservation of biodiversity (Kotze et al., 1995). A worldwide inventory has confirmed that these habitats are under threat nearly everywhere due to the pressures of human utilization and environmental degradation (Finlayson et al., 2002). Conservation planning for wetlands benefits from a classification of wetland habitats and such habitat descriptions are based on wetland vegetation (Driver et al., 2011). Vegetation structure and species composition are important aspects of the habitat for many animals and therefore, descriptions of vegetation types are often used as a proxy for biodiversity in general. Since wetlands are generally small units in the landscape they have often been overlooked in large-scale vegetation studies. Mucina and Rutherford (2006) incorporated wetlands in the National Vegetation Map of South Africa, but acknowledged that many of the smaller wetlands were not represented, nor was the full range of wetland vegetation diversity.

Wetland environments are characterized by soils that are depleted of oxygen due to extended periods of inundation (termed anoxic soils), but in many wetlands this inundation occurs only during a limited seasonal period (Mitsch and Gosselink, 2000; Keddy, 2004). For this reason, permanently anoxic soils are absent and the plants have to deal with dynamic conditions, particularly alternating flood levels (Keddy, 2004). This is particularly the case in floodplain areas where the water influx is mainly dependent on floodwaters (Ollis et al., 2013). In most cases, wetland vegetation in these situations is dominated by short lawn grasses that are particularly well adapted to deal with various disturbances such as seasonal fluctuations from dehydration to inundation, deposition, trampling and grazing. Many of these grasslands are dominated by grass species of the genus *Cynodon*, particularly *C. dactylon* (Kweek). Because seasonal wetlands have oxygenated periods they tend to harbour more species than most other wetlands. However, these species are not specifically adapted to the wetland environment, but rather to regular disturbance (Grime, 2001).

In South Africa, the first description of this type of wetland vegetation was by Furness and Breen (1980) for the Pongola river floodplain. This vegetation on this floodplain was considered to be of special

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conservation importance, as the grasslands dominated by *C. dactylon* are quite rare in KwaZulu-Natal Province. Since then, similar communities were described from pans in the North West and Free State Provinces (Fuls et al., 1992; Cilliers et al., 1998; Cilliers and Bredenkamp, 2003; Janecke et al., 2003).

A recent overview of wetland vegetation in South Africa (Sieben et al., 2014) showed that short lawn grassy wetland vegetation occurs in three distinct regions: the Western Cape, where wetlands are embedded within the lowland Renosterveld vegetation; the semi-arid zones of the western parts of the Free State and North West Provinces; and floodplains in the subtropical areas, particularly along the Limpopo and Pongola rivers.

Many grasses are well adapted to disturbance as they are able to grow fast after aboveground biomass is destroyed (Tainton, 1999) by grazing or fire. Other stresses include periodic inundation and sediment deposition which *Cynodon dactylon* can tolerate. Some of the pans that are dominated by salt-tolerant grasses of the genus *Sporobolus* show an affinity with *C. dactylon* communities but, in the current study, we do not include them as they are dealt with in their own manuscript which describes saline and brackish communities (Sieben et al., 2016).

In this study, we present an overview and classification of the vegetation of a specific type of wetland habitat. These wetlands are dynamic in nature, to such an extent that drought is a constraint to plant growth for a part of the year, because of large water table fluctuations that drop deep below the ground surface, but that are not affected by saline conditions. *Cynodon dactylon* and other short grasses as well as many short-lived ruderal species are dominant in these wetlands. The name 'short lawn grassy wetlands' is used as an over-arching categorization, although there are certainly also communities within this category that are dominated by species that are not short nor members of the grass family. There are also wetlands occurring at high altitudes that have short species. These wetlands are categorized as 'Montane grassy wetlands' and were excluded from this study. The aim of the study is to present a floristic classification of the 'grass lawn wetlands' as described above, as well as to present an overview of the environmental factors that may explain their differentiation and occurrence.

2. Methods

The Braun–Blanquet method is the standard method for vegetation data collection and was developed so that vegetation data can be compared across large areas among different investigators (Westhoff and Van der Maarel, 1978; Brown et al., 2013). The method prescribes how vegetation should be sampled in quadrants of a fixed size that represent the larger vegetation stand in terms of species composition and dominance structure. These data on plant species composition are then entered into the database programme Turboveg (Hennekens and Schaminée, 2001), where it can be properly managed and compared. The comparison is important as there was already data available from similar ecosystems and these historical data were collated and combined with new data from historically undersampled areas. This overall effort culminated in the development of the South African National Wetland Vegetation Database (Sieben et al., 2014), in which Grass lawn wetland vegetation represent a part of all the wetlands sampled. This group of wetland vegetation is represented by 576 vegetation plots, of which 217 plots were newly collected. The various historical studies where the other data were sourced from are listed in Table 1. A few of these studies are indicated in grey; these are the studies where the contribution of vegetation plots to the group of grass lawn wetland vegetation is small.

A standardized sampling protocol has been devised to supplement the vegetation data with environmental data relevant for wetland habitats. Additionally, in the newly collected plots, there were soil samples from the topsoil collected (at most one sample per wetland). Table 2 lists all the environmental variables that are available either for all the plots or just a part of it (in the case of soil variables, marked with an asterisk), and indicates whether these variables were actually measured or assessed. Ordination analysis requires detailed explanatory data and therefore it has been restricted to those plots where all environmental data is available (including those marked with an asterisk). One of the most important environmental 'explanatory' variables listed in Table 2, is the hydrogeomorphic unit as discussed by Ollis et al. (2013). Their classification has been simplified for the purposes of the current study and the wetlands from which plots were sampled were categorised as belonging to one of the following wetland types: floodplain, depression, seepage or valley bottom. However, even though the hydrogeomorphic (HGM) unit is an important aspect of the description of wetlands, plant growth itself is much more dependent on local conditions such as the availability of nutrients, water and light and the presence of any stresses or limitations to productivity (Grime, 2001; Collins, 2011). The most important habitat descriptor in wetlands that directly affects plant growth is the hydroperiod, which can be described as the average period in which a certain area is inundated or saturated and thereby subjected to anoxic conditions each year (Kotze et al.,

Table 1
Historical datasets included in the present dataset. The grey datasets at the bottom of the graph have only a very small amount of data plots from grass lawn wetlands available.

Publication / dataset	Area	Comments	No. of plots
Furness (1981)	Pongola floodplain	Vegetation plots 10 × 10 m	23
Boucher (1987)	West Coast	Vegetation plots of 10 × 10 m, heterogeneous	5
Fuls, Bredenkamp & Van Rooyen (1992)	Pans of Northwestern Free State	No coordinates, poor environmental data	6
Cilliers, Schoeman & Bredenkamp (1998)	Urban wetlands in Potchefstroom	Three wetlands in detail	41
Neal (2001)	Mkhuze floodplains	Plots on transects, no wetness data	31
Malan (2003)	Cookes Lake recreational area, Mmabatho	One urban wetland, largely disturbed	35
Janecke, DuPreez & Venter (2003)	Soetdoring Nature Reserve	Two wetlands	11
Cilliers & Bredenkamp (2003)	Pans in Northwest Province	Four large pans, many plots with very poor cover	18
Cleaver, Brown & Bredenkamp (2004)	Kamanassie Mountains	Maybe not all clear wetlands, small springs, plot size variable	4
Fouche (2008)	Florisbad	One wetland	10
Van Aardt (2010)	Vet River	No coordinates, poor environmental data	30
Collins (2011)	Free State pans and Valley bottoms	Soil data and many other variables available	23
Corry (2011)	Western Cape lowlands	Soil data and many other variables available for most plots	100
Pretorius (2011)	Wetlands Nothern Maputaland	Results not yet published and soil data not yet available	7
Cowden, Kotze, Ellery, Sieben (2014)	Rehabilitated wetlands in KwaZulu-Natal	Many disturbed sites, not yet published	4
Coetzee, Bredenkamp & Van Rooyen (1993)	Belfast–Wakkerstroom–Barberton–Piet Retief		1
Coetzee, Bredenkamp & Van Rooyen (1994)	Wetlands of Heidelberg, Witbank, Pretoria area		1
Bezuidenhout (1995)	Graspan–Holpan section Vaalbos National Park		2
Schoultz (2000)	Mkhuze Swamps		3
Taylor (2000)	Mdlanzi Pan, Zululand		1
Goge (2002)	Eastern shores Lake St. Lucia		1
Venter (2002)	Mfabeni Swamp, Eastern shores		1
Kareko (2002)	Middelvlei Wetland, Stellenbosch		3