South African Journal of Botany 97 (2015) 133–142

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Plant census and floristic analysis of selected serpentine outcrops of the Barberton Greenstone Belt, Mpumalanga, South Africa

S.D. Williamson *, K. Balkwill

School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

ARTICLE INFO

Article history:
Received 28 March 2014
Received in revised form 19 November 2014
Accepted 3 December 2014
Available online 28 January 2015

Edited by OM Grace

Keywords:
Barberton Greenstone Belt
Important families
Floristics
Metalliferous outcrops
Serpentine endemics
Serpentinite
Ultramafic rocks

ABSTRACT

This paper aims to characterise and describe the species composition of serpentine sites of the Barberton Greenstone Belt as compared to surrounding non-serpentine areas. A floristic analysis of seven serpentine (serpentinite) outcrops of the Barberton Greenstone Belt, in the eastern part of South Africa, recorded 744 species and subspecies, 319 genera and 94 families. 18 taxa remain undescribed. The Barberton Greenstone Belt flora includes 32 taxa endemic to serpentine soils and six taxa considered to be hyperaccumulators of nickel. The taxa considered to be endemic to serpentine outcrops make up 39% of the number of endemics found within the Barberton Centre of Endemism. The serpentine vegetation is characterised by fewer trees than the surrounding vegetation and the dominance of grass species such as *Themeda triandra*, *Heteropogon contortus* and *Loudetia simplex*. The species composition of each outcrop is relatively unique with only about 30% of species shared between any pair of outcrops. The flora of the serpentine outcrops of the Barberton Greenstone Belt is found to be different to the surrounding non-serpentine vegetation in terms of number of species per family, the ratios of dicotyledons to monocotyledons and familial composition.

© 2014 SAAB. Published by Elsevier B.V. All rights reserved.

1. Introduction

Outcrops of serpentinite (henceforth referred to as 'serpentine') rocks are often referred to as edaphic islands due to their sharp boundaries and patchy distribution. Soils derived from serpentine rocks are considered a harsh environment for plants due to low levels of calcium relative to magnesium, low nutrient content, nickel and chromium toxicity and poor water holding capacity (Harrison et al., 2006). The extreme physical and chemical properties of serpentine soils provide conditions that allow colonisation by tolerant species and then strong diversifying selection processes may lead to ecological speciation (Kruckeberg, 1986; Rajakaruna, 2004). Species of plants tolerant to serpentine soils include species found only on serpentine soils i.e. serpentine endemics; species that are local or regional indicators but are not restricted to serpentine and species that are serpentine indifferent (Kruckeberg, 1984). Taxa that are found on adjacent non-serpentine substrates but are completely excluded from serpentine soils (Harrison et al., 2006) are also important for defining the distinctiveness of serpentine floras.

Physiological and evolutionary mechanisms hypothesised to be responsible for adaptations to serpentine soils include the tolerance of a low calcium-to-magnesium ratio, avoidance of Mg toxicity, or a high Mg requirement (Brady et al., 2005). In a floristic analysis of the serpentine vegetation of Central Queensland, Australia, Batianoff et al. (2000) suggested a family tolerance of soil conditions and postulated that some families are characterised by higher proportions of serpentine tolerant species. It is also thought that edaphic conditions strongly influence species diversity and levels of endemism. Batianoff et al. (2000) found that species richness of the serpentines of Central Queensland in Australia decreased as soil nickel concentrations increased in lowland forests and that levels of endemism increased with increasing nickel concentrations. In the Californian serpentine vegetation, soil calcium levels were negatively correlated with the number of serpentine endemic taxa (Harrison, 1999).

The flora of the serpentine outcrops of the Barberton Greenstone Belt in the eastern parts of South Africa have been less well documented than those of Cuba (Borhidi, 1992), New Caledonia (Jaffré, 1992), California (Kruckeberg, 1984; Callizo, 1992), Zimbabwe (Wild, 1965), Australia (Gibson and Lyons, 1998a,b, 2001; Batianoff et al., 2000) and Italy (Ferrari et al., 1992; Verger, 1992). Most of these studies have lead to the identification of many plant species endemic to serpentine soils. The lack of knowledge of the floras of the metalliferous sites in South Africa initiated a funded research programme entitled 'Metalliferous Flora' and focused on the study of the floristics, biodiversity, conservation, soils and evolution of these floras. This study supplements floristic analyses conducted previously on parts of the Barberton Greenstone Belt by Williamson (1994), Changwe and Balkwill (2003) and McCallum (2006).

* Corresponding author. Tel.: +61 8 9581 9180.
E-mail address: sandyw@webmail.co.za (S.D. Williamson).

http://dx.doi.org/10.1016/j.sajb.2014.12.004
0254-6299/© 2014 SAAB. Published by Elsevier B.V. All rights reserved.

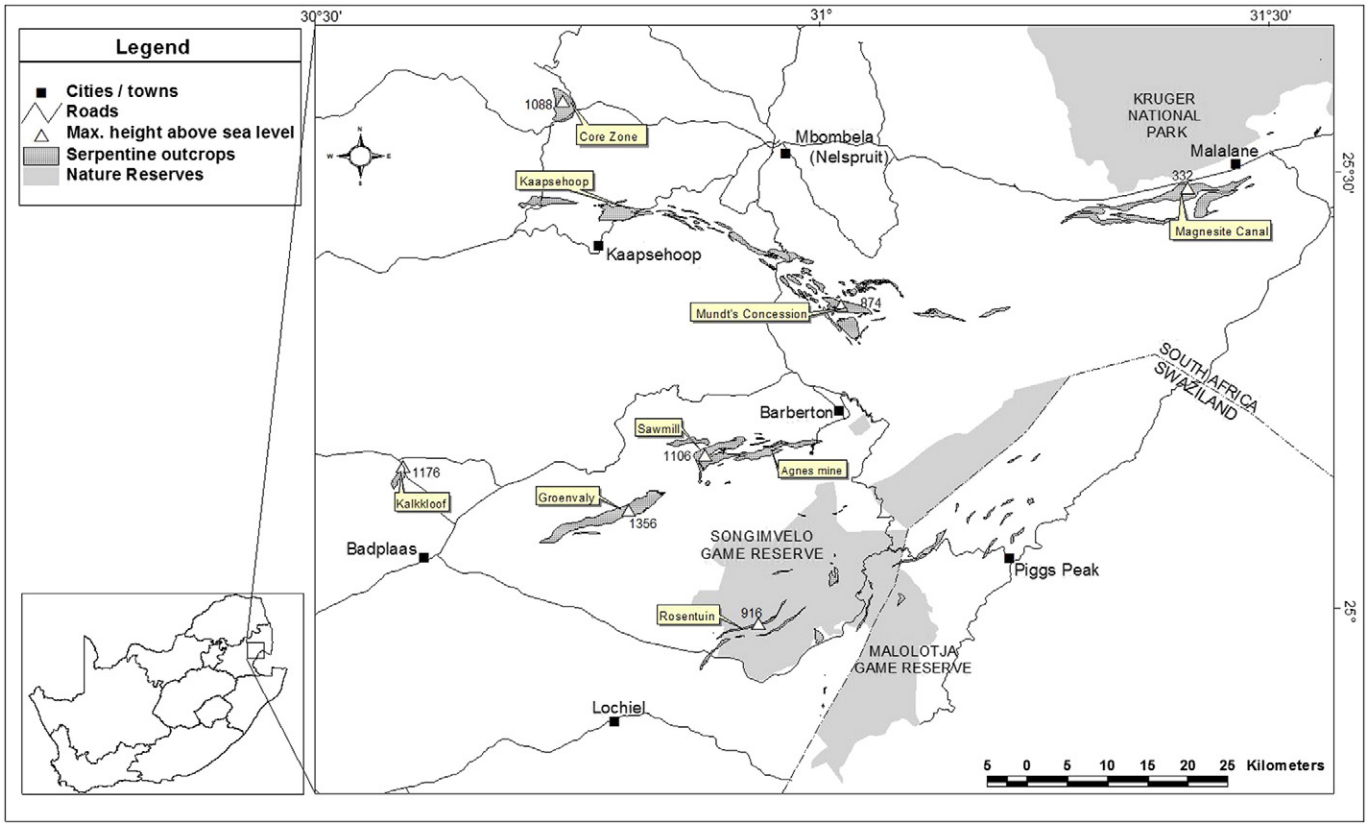

Fig. 1. Map indicating serpentine outcrops of the Barberton Greenstone Belt in Mpumalanga, South Africa. Survey sites are identified by callout labels. Map was prepared using data provided by the Chief Directorate: Surveys and Mapping, Department of Land Affairs, Republic of South Africa.

The Barberton Greenstone Belt is located in south-eastern Mpumalanga, South Africa (Fig. 1). This province has an estimated 4946 plant species and infraspecific taxa occurring within its boundaries, yet it only comprises 6.3% of South Africa's surface area (Lötter et al., 2002). This high level of plant diversity is not evenly distributed across Mpumalanga. Two regions and three Centres of Endemism were recognised by Van Wyk and Smith (2001) and an additional one for the Lydenburg area was proposed by Lötter et al. (2002). The Barberton Greenstone Belt falls within the Barberton Centre of Endemism, which has an area of about 4000 km^2, has about 2210 plant species and more than 80 endemics with 3.6% endemism. A large percentage (>29%) of this area is transformed by commercial plantations of species of *Pinus* and *Eucalyptus* (Lötter et al., 2002), threatening many of the endemics on serpentine and other ultramafic substrates (Williamson and Balkwill, 2006).

The Barberton Greenstone Belt consists of approximately 30 large serpentine outcrops in the belt surrounded by several very small outcrops (Ward, 2000). These outcrops are located in an inverted equilateral triangle centred on Barberton and extending to Malelane in the east and to Badplaas in the south. The Barberton Greenstone Belt is surrounded by extensive granitoid plutons and gabbroid intrusions. The serpentine outcrops consist of various combinations of serpentinised dunite, amphibolite, chrysotile asbestos and peridotite (Morrey et al., 1992). The largest of these outcrops is about 19 km^2, and there are several smaller outcrops (from 0.1 km^2). Some outcrops are separated from others by up to 20 km (Balkwill et al., 1997). The outcrops occur in mountainous areas and are heterogeneous in altitude, slope, soil depth and other topographic features. The serpentine vegetation falls within the Mixed Lowveld Bushveld, Sour Lowveld Bushveld and North-eastern Mountain Grassland vegetation types as described by Low and Rebelo (1996). It has more recently been reclassified as Barberton Serpentine Sourveld by Mucina and Rutherford (2006) due to the unique, stunted woody vegetation that results from the high toxicity of the soils. The landscape of the areas surrounding the serpentine outcrops of the Barberton Greenstone Belt is mostly hilly with varied terrain. The outcrops range from 350 to 1400 m above sea level. The climate of the area is characterised by summer rainfall (MAP 600–1150 mm) with dry winters, during which frost is infrequent.

Table 1
List of outcrops selected as study sites with two additional sites studied previously (Williamson, 1994) and a summary of environmental conditions used for selection.

Serpentine site	Approx. area (km^2)	Altitude range (m.a.s.l)	Mean annual rainfall (mm)	Reason for selection of site
CoreZone (CZ)	9.3	780–1189	800–950	Furtherest north
Kalkkloof (KK)	2.0	1176–1300	650–800	Furtherest west and 3rd highest
Magnesite Mine (MM)	13.7	354–575	650–800	Furtherest east and lowest altitude
Groenvaly (GV)	18.7	1000–1540	800–950	Largest
Mundt's Concession (MC)	5.8	620–889	800–950	Intermediate area and altitude
Sawmill (SM)	6.7	900–1192	950–1100	Intermediate area and altitude
Rosentuin (RT)	0.3	1200–1400	950–1100	3rd smallest
Agnes Mine (AM)	9.7	900–1100	950–1100	
Kaapsehoop (KH)	7.6	1430–1580	800–950	

Download English Version:

https://daneshyari.com/en/article/4520569

Download Persian Version:

https://daneshyari.com/article/4520569

Daneshyari.com