Available online at www.sciencedirect.com

ScienceDirect

South African Journal of Botany 77 (2011) 94 – 104

SOUTH AFRICAN JOURNAL OF BOTANY

www.elsevier.com/locate/sajb

The Boschberg (Somerset East, Eastern Cape) — A floristic cross-roads of the southern Great Escarpment

V.R. Clark [a,*], N.P. Barker [a], C. McMaster [b], L. Mucina [c]

[a] *Department of Botany, Rhodes University, Grahamstown 6140, South Africa*
[b] *Cameron McMaster, African Bulbs, P.O. Box 26, Napier 7270, South Africa*
[c] *Department of Environmental and Aquatic Sciences, Curtin University of Technology, GPO Box U1987, Perth WA 6845, Australia*

Received 16 December 2009; received in revised form 21 June 2010; accepted 25 June 2010

Abstract

The Boschberg and Groot-Bruintjieshoogde form the wettest and floristically most distinct section of the Sneeuberg mountain complex. As such they warrant a separate detailed investigation, particularly in terms of their connectivity between the main Sneeuberg in the west, the Great Winterberg–Amatolas in the east, and with the Cape Floristic Region (CFR) to the south and south-west. Following a detailed botanical investigation and overview we conclude that the Boschberg and Groot-Bruintjieshoogde are a floristic hub between the CFR and southern Great Escarpment, as well as between the moister eastern and drier western components of the Great Escarpment. Our data confirm that the Boschberg forms part of the south-eastern connection between the CFR and the Afromontane region in southern Africa, a connection first suggested by Weimarck (1941).

Keywords: Boschberg; Cape Floristic Region; Floristics; Groot-Bruintjieshoogde; Phytogeography; Sneeuberg Centre of Endemism

1. Introduction

The Boschberg and Groot-Bruintjieshoogde are located in the Somerset East District of the Eastern Cape Province in South Africa and together comprise the south-eastern end of the Sneeuberg mountain complex (hereafter referred to as the Sneeuberg) in the Sneeuberg Centre of Plant Endemism (Clark et al., 2009). The Boschberg is a ridge that extends 40 km from Antoniekop in the west (immediately east of the Little Fish River) to Slagtersnek behind Cookhouse (Fig. 1). Although the whole ridge is technically the "Boschberg" (Van der Walt, 1972), in connotation the name mostly refers to the heavily wooded section of the ridge behind Somerset East (Fig. 2A). The Groot-Bruintjieshoogde is situated between the Boschberg and the Coetzeesberg–Aasvoëlkrans section of the Sneeuberg and is 25 km long. It is separated from the Boschberg by the Little Fish River valley and from Aasvoëlkrans by Buffelshoek-se-Pas (Fig. 1).

The Boschberg and Groot-Bruintjieshoogde differ significantly from the rest of the Sneeuberg in a number of ways. The most obvious difference is that they are much wetter (see later) than the rest of the Sneeuberg, and consequently host many species not found further west along the southern Great Escarpment. Consequently they also host vegetation units different from the rest of the Sneeuberg. So thus, although they are geomorphologically part of the Sneeuberg, they are climatically and phytogeographically closer to the Great Winterberg–Amatolas (Clark et al., 2009; Mucina and Rutherford, 2006; Story, 1952a). For this reason, although the Boschberg and Groot-Bruintjieshoogde were briefly considered in the detailed overview of the Sneeuberg by Clark et al. (2009), their uniqueness in the Sneeuberg warrants a separate detailed overview, particularly given their affinities with the Great Winterberg–Amatolas (thus bringing the significance of the Great Fish River Interval into question — see Clark et al., 2009). The Boschberg and Groot-Bruintjieshoogde are also

* Corresponding author. Tel.: +27 46 6038592; fax: +27 46 6225524.
E-mail address: vincentralph.clark@gmail.com (V.R. Clark).

0254-6299/$ - see front matter © 2010 SAAB. Published by Elsevier B.V. All rights reserved.
doi:10.1016/j.sajb.2010.06.005

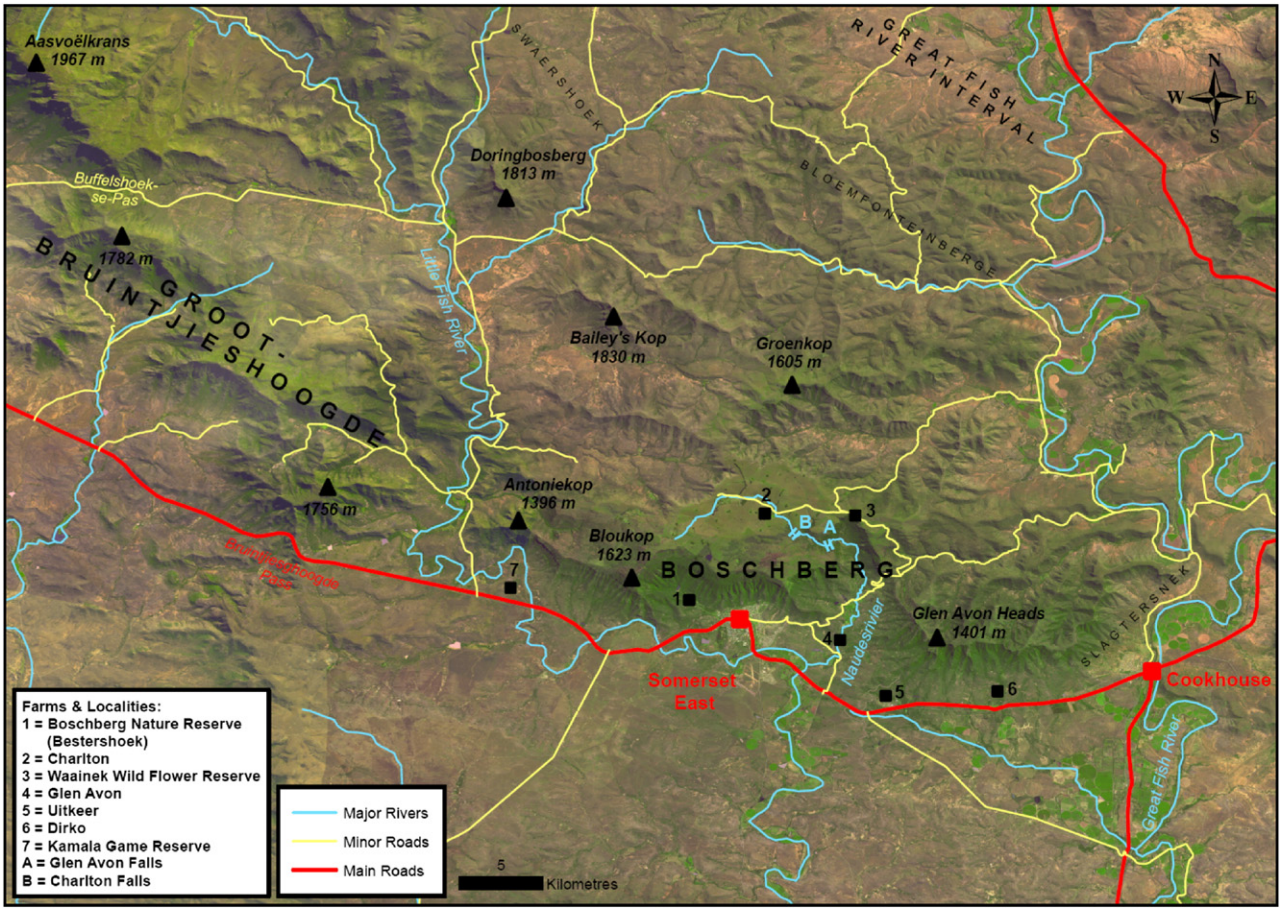

Fig. 1. The Boschberg and Groot-Bruintjieshoogde, in the Sneeuberg Mountain Complex, indicating the highest points, farms used as bases for fieldwork, and localities mentioned in the text. Satellite imagery sourced from the CSIR (2009).

possible key components in Weimarck's (1941) south-eastern connection between the Cape Floristic Region (CFR) (via the Zuurberg 60 km to the south) and the Great Escarpment, and as such would be possibly one of the most important biogeographical connections in southern Africa, as pertaining to the CFR and Drakensberg Alpine Centre (DAC), and perhaps the Afromontane centre in general (e.g. Galley et al., 2007; White, 1983). The south-eastern connection has never been topographically circumscribed: it is here defined as the high ground between the main CFR (which lies to the south-west of the Boschberg) and the Boschberg and Great Winterberg–Amatolas. This high ground consists of the Zuurburg and the mountains around Riebeek-East and Grahamstown (the Swartwatersrand etc.), and forms a patchy eastern end to the CFR (Mucina and Rutherford, 2006), which Weimarck (1941) called his "Zuurberg Subcentre" of the Cape flora. The relatively high ground between the Zuurberg and the Boschberg, and between the Riebeek-East mountains and the Kagaberg (behind Bedford in the Great Winterberg–Amatolas), form part of this connection but were probably only last instrumental during the Last Glacial Maximum.

The presence of several taxa that are endemic and near-endemic (Clark et al., 2009; McMaster, 2007a, 2009) or "lost" (*Protea lorifolia* and *Diascia ramosa*; Rebelo, 2001; Hilliard and Burtt, 1984; note that species author names are not repeated in the text for species listed in the Boschberg flora contained in Appendix A) is a further motivation for a detailed floristic analysis of these mountains. An additional motivation rests on the fact that although plant collecting in the area has been ongoing since the second half of the 1800s, the flora has never been comprehensively documented, and this is always a worthwhile endeavour in itself, particularly for conservation planning and in terms of the public interest in the Boschberg.

2. The physical and historical environment of the Boschberg and Groot-Bruintjieshoogde

2.1. Geology and geomorphology

The geology of the Boschberg is dominated by Beaufort Group sediments (sandstones and shales) inconspicuously capped with dolerite (Clark et al., 2009). In terms of altitude, the Boschberg is the lowest section of the Sneeuberg, only reaching 1623 m above sea level at its highest point (Bloukop; Figs. 1 and 2F). The general plateau altitude is between 1300 and 1550 m above sea level, and the summit plateau is gently undulating with occasional outcrops (small "tors") of dolerite boulders. The southern slopes are steep to precipitous and form a low altitude section of the Great Escarpment complimentary to

Fig. 2. A selection of photographs from the Boschberg and Groot-Bruintjieshoogde: (A) the wooded nature of the Boschberg (summit 1300 m), Farm Glen Avon; (B) contrast between culturally-maintained grassland and moribund fynbos, Boschberg summit plateau (1400 m); (C) the Groot-Bruintjieshoogde as viewed from the Farm Rietfontein (1000 m on road); (D) the rolling Boschberg summit plateau, dominated by Amathole Montane Grassland (1300–1500 m); (E) remote waterfall in the Boschberg Nature Reserve; (F) fynbos near Bloukop (1600 m), Boschberg Nature Reserve.

the Kagaberg behind Bedford on the opposite (eastern) side of the Great Fish River valley from the Boschberg.

The geology and geomorphology of the Groot-Bruintjieshoogde are more typical of the rest of the Sneeuberg, comprising Beaufort Group sediments intruded by massive dolerites and forming an imposing Great Escarpment front (Clark et al., 2009). The Groot-Bruintjieshoogde has a dramatic scarp on its western and southern sides (Fig. 2C), but generally drops away more gently to the east and north. The summit plateau is between 1600 m and 1750 m above sea level with a highest point of 1782 m, near Buffelshoek-se-Pas (Fig. 1). Although not much higher than the Boschberg in terms of absolute elevation, the Groot-Bruintjieshoogde is nevertheless more dramatic in terms of relative elevation.

2.2. Soils

The Boschberg summit plateau hosts a very rich, black-brown clay turf soil derived from dolerite (Van der Walt, 1972). This soil is relatively acidic and has a low status of dissolved minerals (Van der Walt, 1972). Elsewhere, the soil consists of shallow *in situ* lithosols or colluvium, with deep (1–3 m) alluvial deposits along the Naudesrivier and the Little Fish River. As for the Boschberg summit, the Groot-Bruintjies-hoogde summit also has dolerite-derived clayey soils. Generally in the area, sandstone soils are shallower, nutrient-deficient and stony, while dolerite soils are deeper and more fertile and have a very high clay fraction (Van der Walt, 1972; Clark et al., 2009).

2.3. Climate

The Boschberg has a steep rainfall gradient from south to north. Bestershoek, at the base of the Boschberg in the Boschberg Nature Reserve, receives 699 mm per annum (Van der Walt, 1972), while the south and south-east-facing sections of the Boschberg Nature Reserve receive about ca. 800 mm (Somerset East Municipality, sine anno; Somerset East Transitional Council, sine anno). The upper slopes and crest receive between 900 and 1000 mm per annum (G. Brown, pers. comm.; B. Brown, pers. comm.; Wilken pers. comm.). This is the highest rainfall in the Sneeuberg, and is comparable to the wet, south-facing slopes of the Great Winterberg (Scott, pers. comm.). Northwards, rainfall drops off quickly away from the Great Escarpment edge, for instance the Farm Charlton, approximately four kilometres inland from the Great Escarpment edge (Fig. 1), receives 579 mm (Van der Walt, 1972). The Boschberg receives most of its rain in the summer (Van der Walt, 1972). March is the wettest month and June the driest, with May–August receiving less than 30 mm (Van der Walt, 1972). Summer thunderstorms originate in the north and north-east, while gentle rains (which can occur any time of the year) come from the south and south-east (Van der Walt, 1972). Orographic rain from the south-east is no doubt responsible for the higher rainfall along the Great Escarpment crest (Van der Walt, 1972). During fieldtrips in November and December 2008 (a drought summer), work was often hampered by such rain, and mist was frequent. Mist and rain can thus be taken as regular features of the Boschberg, with mist a significant contributor to effective moisture. Snow occurs annually on the summit plateau, mostly in June (Van der Walt, 1972).

No temperature data is available for the summit, but as for the rest of the Sneeuberg the effect of altitude on the Boschberg is clearly evident. Somerset East itself has average daily maximum temperatures of just under 20 °C in July to ca. 28 °C in January, and average daily minimum temperatures of ca. 6 °C in July to 15 °C in January (Van der Walt, 1972). Relative humidity is very high at the base of the Boschberg (pers. obs.), Van der Walt (1972) indicating average December values at 254 mm as measured from a Class A pan. In general, the Boschberg can be classified as having a sub-humid warm climate surrounded by a semi-arid warm climate (Van der Walt, 1972).

Although little climatic data are available for the Groot-Bruintjieshoogde, it is evident that a similar regime as on the Boschberg is present. The south and south-east-facing slopes, crests and summits are very wet (ca. 800 mm; Staples, pers. comm.) and much cooler than the north-facing and west-facing slopes (ca. 400–500 mm). This is evident from the vegetation transitions from moist thicket-forest on the southern slopes to rich Afromontane grassland on the summit plateaux, to dry karroid grassland and thicket on the northern and western slopes. The Groot-Bruintjieshoogde is a climatic transition zone between the Boschberg and the rest of the Sneeuberg.

2.4. Hydrology

The Boschberg is drained entirely by the Little Fish and Great Fish Rivers. Of special interest is the 80 m-high Glen Avon Falls – at the head of the Naudesrivier Valley – and Charlton Falls, slightly further upstream on the Boschberg plateau (Fig. 1). The Groot-Bruintjieshoogde forms part of the watershed between the Sundays River (the Voëlrivier, a main tributary of the Sundays, arises behind Pearston; Fig. 1) and Little Great Fish River systems. Most rivers and streams in the area are episodic or non-perennial, with those on the wetter, southern slopes more likely to have reliable flow than those on the drier, northern slopes. The precipitous southern slopes of the Boschberg above Somerset East are renowned for the numerous cascades and waterfalls evident in the summer rainfall season (Fig. 2E).

2.5. Historical land-use and vegetation

One of the first European settlers in the area was Willem Prinsloo, who was farming at the base of the Boschberg from 1771 (Bergh and Visagie, 1985; Raper and Boucher, 1988; Walker, 1936), predating the settlement of Somerset East. Somerset East (originally called Somerset) was initiated in about 1817 as a British government farming scheme to provide fodder for the British border troops, and was declared a town in 1825 (Van der Walt, 1972). The Boschberg was heavily exploited for its timber in the latter 1700s and in the 1800s, supplying Outeniqua Yellow-wood *Afrocarpus falcatus* for the building industry, Sneezewood *Pteroxylon obliquum* for the farming industry, and as an informal source of firewood for Somerset East itself (Le Vaillant, 1790; Raper and Boucher, 1988; Van der Walt, 1972). The Somerset East area is currently a major agricultural area, with irrigation agriculture (e.g. lucern) along the Little Fish River, sheep and cattle farming both on the Boschberg and Groot-Bruintjieshoogde and on the plains below, game farming and eco-tourism (e.g. Kamala Game Reserve, fly-fishing at Glen Avon, Glen Avon Falls, farm holidays etc.). Cultivation in some of the Groot-Bruintjies-hoogde valleys has apparently long been abandoned and those areas are now very badly eroded. The Boschberg Nature Reserve (ca. 2050 ha; Somerset East Transitional Council, sine anno) was established in 1937 (Van der Walt, 1972) and is owned by the Somerset East Municipality. It has a two-day hiking trail and overnight hut, otherwise it has been a declared

water catchment for Somerset East since 1885, with reservoirs such as Mountain Reservoir and Bestershoek Dam (Van der Walt, 1972). The Fish-Sundays water transfer scheme exits the Boschberg at Uitkeer, between Somerset East and Cookhouse.

With human activity comes the inherent infestation of undesirable plant species. *Nassella trichotoma* (Nassella Grass/-Pol), a South American grass species (Henderson, 2001), is a scourge on the Boschberg and Groot-Bruintjieshoogde. It now covers large tracts of summit plateau. This situation requires emergency measures in order to combat this very serious invader (Bromilow, 1996). The overall impact on biodiversity and rangeland value by this grass is very high and very negative (Boerdery in S.A., 1965; Bromilow, 1996), particularly as infestations have been present since at least the 1970s and currently run into the hundreds of hectares. Given the ease by which *Nassella* is wind-distributed (Bromilow, 1996), the *Nassella* infestations are probably feeding seed westwards onto the main Sneeuberg and possibly also eastwards onto the Great Winterberg–Amatolas where the species is also locally problematic. The species is encouraged through overgrazing and soil disturbance, and eventually out-competes indigenous grasses to form pure, unpalatable stands (Boerdery in S.A., 1965; Bromilow, 1996).

Acacia mearnsii (Black Wattle) is an invader of watercourses and grassland on the Boschberg plateau. A bio-control agent (the weevil *Melanterius maculatus*; Agricultural Research Council, 2006) was released on the Boschberg in November 2008 and will hopefully assist in curbing this species. *Pinus patula* (Patula Pine), planted once as wind-rows on the Boschberg plateau, has become a serious invader of these plateau grasslands and fynbos. It requires attention, especially below Mountain Reservoir. *Rosa rubiginosa* (Sweet Briar), prevalent on the Aasvoëlkrans and Bankberg sections of the Sneeuberg (Clark et al., 2009), is also potentially problematic in the Boschberg and Groot-Bruintjieshoogde and forms dense thickets if left untreated. *Sambucus nigra* (Elderberry), widespread and occasional at the base of moist cliffs in the Sneeuberg (Clark et al., 2009), is also problematic on at least the Farm Glen Avon at the base of cliffs in forest. *Solanum pseudocapsicum* (Jerusalem Cherry) is a widespread problem in Boschberg forest understory (as well as in kloofs west along the lower Sneeuberg Escarpment below the Graaff-Reinet-Murraysburg road); the Browns are doing an excellent job at combating this plant on their farm. Typical invaders of the drier plains and lower slopes in the area are *Nicotiana glauca* (Tree Tobacco), *Opuntia* spp. (Prickly Pear) and *Agave americana* (Century Plant).

There has been an increase in conservation awareness in the region since the publication of Sim's (1907) work on the forests of the then Cape Colony. Apart from the Boschberg Nature Reserve (discussed above), the Waainek Wild Flower Reserve has been established by local farmer Philip Erasmus to protect a section of the Boschberg summit grassland (McMaster, 2007a, b, 2009). The Glen Avon Falls and valley have been designated as a Natural Heritage Site, and most recently several private game reserves have become established in the area. The Boschberg Nature Reserve is also in the process of receiving a stronger conservation zoning with associated environmental management plans including the re-introduction of Cape Parrot *Poicephalus robustus* and a proper burning regime (Wilken pers. comm.).

The main issues requiring urgent attention are the alien invaders (Nassella, Pine and Wattle), soil erosion in parts of the Groot-Bruintjieshoogde, and protection for some of the rarer endemic and near-endemic species (e.g. *Dierama grandiflorum* and *Kniphofia acraea*). There is also probably a high local demand for plant material for traditional uses.

3. Pioneer botanical work

Clark et al. (2009) provide an overview of historical plant collectors in the Sneeuberg region. It would appear that most pioneer botanical work in the Boschberg and Groot-Bruintjieshoogde was undertaken by Peter MacOwan and Harry Bolus, as most historical specimens from the Boschberg and Groot-Bruintjieshoogde in Selmar Schönland Herbarium (GRA) are from these gentlemen (Clark et al., 2009), although lesser amounts have been undertaken by others (Gunn and Codd, 1981). A phyto-ecological study of the Boschberg – concentrating on the impacts of grazing – was undertaken by Van der Walt (1972). His work remains the most comprehensive survey of the vegetation of the Boschberg to date. More recent work on the Boschberg has been done by the second author, particularly relating to local endemics and the establishment of the Waainek Wild Flower Reserve (Dold and McMaster, 2005; McMaster, 2007a, b, 2009). The surveys conducted for this paper however represent the first known comprehensive floristic survey of the Boschberg and Groot-Bruintjieshoogde.

4. The botanical environment of the Boschberg and Groot-Bruintjieshoogde

Four biomes occur in the region, namely Grassland, Afrotemperate Forest, Albany Thickets and Nama-karoo (Mucina and Rutherford, 2006). The relatively low altitude of the Boschberg and Groot-Bruintjieshoogde, the dissected topography, and the relatively higher rainfall than the rest of the Sneeuberg, have resulted in these biomes inter-digitating with each other, especially Afrotemperate Forest and Thicket. Nama-Karoo, being peripheral to this area – and having been well-documented for the main Sneeuberg complex by Clark et al. (2009) – is not considered here.

4.1. Grassland

The summit grassland of the Boschberg is described by Mucina and Rutherford (2006) as Amathole Montane Grassland (their spelling). This vegetation unit occurs along the southern Great Escarpment from the Groot-Bruintjieshoogde in the west to the Stutterheim and Komga in the Great Winterberg–Amatolas in the east (Mucina and Rutherford, 2006). On the Boschberg it is confined to the wetter summit crests and summit plateau, and with loss of altitude and northerly aspect quickly gives way to Karoo Escarpment Grassland (Mucina and Rutherford, 2006; detailed in Clark et al., 2009, and not considered further here), *Acacia karroo*

woodland, and dry Great Fish Thicket (Mucina and Rutherford, 2006; see below). Amathole Montane Grassland differs significantly from Karoo Escarpment Grassland (which is typical of the rest of the Sneeuberg; Clark et al., 2009; Mucina and Rutherford, 2006) by an absence of *Merxmuellera disticha* and a dominance of *Themeda triandra* and a greater presence of other moister montane grasses such as *Andropogon appendiculatus*, *Brachiaria serrata*, *Brachypodium flexum*, *Cymbopogon nardus*, *Eragrostis capensis*, *Eustachys paspaloides*, *Festuca scabra*, *Harpochloa falx*, *Koeleria capensis* and *Tristachya leucothrix*. Many forbs and geophytes that are only found at higher altitudes on the Sneeuberg are common on the wetter, lower altitude Boschberg. Typical forb, geophyte and suffrutex species are *Alchemilla bicarpellata*, *Cyrtanthus macowanii*, *C. tuckii*, *Geranium harveyi*, *Geum capense*, *Haplocarpha nervosa*, *H. scaposa*, *Indigofera cuneifolia*, *I. mollis*, *Lachenalia campanulata*, *Moraea elliotii*, *Nemesia umbonata*, *Wahlenbergia krebsii* subsp. *krebsii*, etc. *Helichrysum* species are particularly abundant (Mucina and Rutherford, 2006) and include *H. anomalum*, *H. appendiculatum*, *H. aureonitens*, *H. aureum*, *H. ecklonis*, *H. felinum*, *H. microniifolium*, *H. montanum*, *H. nudifolium* var. *nudifolium* and var. *pilosellum*, *H. odoratissimum*, *H. petiolare*, *H. splendidum*, *H. trilineatum*, *H. umbraculigerum* and *H. xerochrysum*. This habitat also hosts numerous regionally endemic and rare species such as *Dierama grandiflorum*, *Disa lugens* var. *lugens*, *Haemanthus carneus* and *Kniphofia acraea* (Clark et al., 2009; Dold and McMaster, 2005; McMaster, 2007a, b, 2009).

The summit of the Groot-Bruintjieshoogde can also be classified as Amathole Montane Grassland. It is transitional however, and is not as rich in species as the Boschberg summit grassland. The summit of the southern section of the Groot-Bruintjieshoogde (Fig. 1) is interesting in that it hosts massive colonies of *Watsonia pillansii*, a species not found elsewhere in the Sneeuberg but is common eastwards onto the Great Winterberg–Amatolas. The upper slopes, seeps and areas near cliff-lines are swathed in massive colonies of *Agapanthus praecox*, these colonies petering out in the west on the Farm Buffelshoek behind Pearston.

The very prominent fynbos component evident on the Boschberg and sections of the Groot-Bruintjieshoogde can possibly be assigned to Mucina and Rutherford's (2006) Drakensberg-Amathole Afromontane Fynbos vegetation unit, although on the Boschberg and Groot-Bruintjieshoogde it is more typical of the Great Escarpment crest and forest margins than river valleys as stated by Mucina and Rutherford (2006). Drakensberg-Amathole Afromontane Fynbos occurs from the Boschberg along the southern Great Escarpment into the DAC with outliers in northern KwaZulu-Natal (Mucina and Rutherford, 2006). Story (1952a) notes the close similarity of the fynbos on the Boschberg with that on the Amatolas.

There are strong indications that, together with *Buddleja salviifolia*, *Leucosidea sericea* and *Rubus rigidus*, this fynbos invades grassland where fire and grazing are excluded on the Boschberg and Groot-Bruintjieshoogde (e.g. Story, 1952a, b). In the Boschberg Nature Reserve, this vegetation unit occurs as a dense *Erica simulans*, *E. cafforum*, and *Passerina montana* "climax" fynbos up to 2 m high, and vast, dense, and virtually pure/species-poor stands of both *Protea subvestita* and *Leucosidea sericea*. Areas that had been recently burnt at the time of the fieldwork suggest a typical fynbos regeneration/successional process, with many herbaceous and suffrutex species evident. The regenerating *P. subvestita* fynbos in the burnt area near Bloukop in the Boschberg Nature Reserve included species such as *Centella graminifolia* var. *graminifolia*, *Hebenstretia dura*, *Helichrysum felinum*, *Ischyrolepis* sp. aff. *constipata*, *I. distracta*, *Metalasia muricata*, *Morella brevifolia*, *Muraltia alopecuroides*, *M. saxicola*, *Pelargonium glutinosum*, *P. laevigatum* var. *laevigatum*, *Polygala microlopha*, *Osteospermum caulescens*, *Phylica paniculata* and *Senecio tanacetopsis*. A comparable fynbos patch on the Groot-Bruintjieshoogde contained additional species such as *Anthospermum herbaceum*, *Erica caespitosa*, *Ficinia ramossissima*, *Harveya bolusii*, *Merxmuellera stricta*, *Muraltia alticola* and *Schizaea pectinata*. Other typical species, apart from the ones mentioned already, are *Anthospermum monticola*, *Cliffortia eriocephalina*, *C. paucistaminea*, *Erica leucopelta*, *Merxmuellera macowanii*, *Psoralea glabra* and *Restio sejunctus*. *Protea lorifolia*, a CFR species recorded historically on the Boschberg (Rebelo, 2001), has not been rediscovered despite extensive searches since 2008. It was last recorded on the Boschberg by Chris Wilkins about 25 years ago (Wilken, pers. comm.), but the vegetation above Rooikrans – where it was previously recorded – is now virtually impenetrable *P. subvestita* montane thicket-fynbos.

As adjacent commercial farms are characterised by fire- and grazing-maintained grassland, the fynbos can be considered possibly invasive to grassland and indicative of a moribund veld condition (e.g. Story, 1952a, b). If not burnt, it may even give way to forest in suitable circumstances (Story, 1952a). There has probably been a continual interplay between grassland and woody vegetation on the Boschberg and Groot-Bruintjieshoogde, driven mostly by fire (from lightning; e.g. Staples, pers. comm. for the Groot-Bruintjieshoogde burn in spring 2008), decadel climate fluctuations (wetter periods favouring woody vegetation), and large herbivores (cattle and sheep replacing wild game in the past 250 years). Grassland was present on the Boschberg when the first European settlers began farming in the area in the 1770s (Raper and Boucher, 1988), and this together with the numerous grassland endemics and near-endemics indicates that grassland is a natural vegetation type in the area and not an anthropogenically produced one (compare Story, 1952a, b) — although today grassland is anthropogenically maintained as dominant through burning and high livestock density (a good example is the boundary between the Boschberg Nature Reserve and adjacent private land; Fig. 2B).

Bedford Dry Grassland (Mucina and Rutherford, 2006), characterised by *A. karroo* parkland-savannah, dominates the plains below the Boschberg and Groot-Bruintjieshoogde (Clark et al., 2009). This vegetation unit extends from the Bruintjieshoogde Pass in the west to Fort Beaufort in the east, occupying the flats along the base of the Great Escarpment (Mucina and Rutherford, 2006).

4.2. Afrotemperate Forest

Mucina and Rutherford (2006) have included the Boschberg forests in their Southern Misbelt Forest vegetation unit. Southern Misbelt Forest occurs from the Boschberg and Baviaanskloofberge in the Eastern Cape to Ulundi in KwaZulu-Natal (Mucina and Rutherford, 2006). The Boschberg is the western limit of Great Escarpment forest in southern Africa, and is the only section of the Sneeuberg to host a yellow-wood species (*A. falcatus*), some remnant specimens of which are substantial in size. The more typical eastern Great Escarpment yellow-wood species, *Podocarpus latifolius* (Thunb.) R. Br. ex Mirb, does not occur on the Boschberg however, the western limit apparently being Fenella Gorge in the Great Winterberg.

Tall forest on the Boschberg is fragmented and is largely confined to the deeper ravines on south and south-east-facing slopes. It occurs in a matrix of, and intergrades with, Eastern Cape Escarpment Thicket (Mucina and Rutherford, 2006) as well as woodland types dominated by *Celtis africana*, *Kiggelaria africana* and *Olea europaea* subsp. *africana*. Substantial forest patches occur on the Boschberg Nature Reserve, above the Farm Glen Avon (where groves of large *A. falcatus* of ca. 15–20 m tall still occur and are perhaps indicative of the original Boschberg forest prior to disturbance), and in the ravines above Uitkeer and the Farm Dirko (these warrant further exploration).

Van der Walt (1972) motivates for a historically more continuous Boschberg forest in which trees up to 30 m tall where common (probably emergent canopy *A. falcatus*, such as in the Amatola forests today), while R.J. Gordon (in Raper and Boucher, 1988) estimated an *A. falcatus* tree on the Boschberg in 1777 to have a height of 15 m and a circumference of 4.6 m, and the forest in general to be typically characterised by very tall trees. Hilliard and Burtt (1984) and Van der Walt (1972) concur that the Boschberg forests have been badly disturbed. The current fragmented nature of the forest has been attributed to fire from human activity (Van der Walt, 1972), large-scale harvesting of commercial timber in the late 1700s and the 1800s (Van der Walt, 1972), and possibly general aridification since European colonisation (e.g. Sim, 1907; Sugden, 1989), favouring thicket rather than forest regeneration. Forest fragmentation may also have been encouraged by the use of the Boschberg forests behind Somerset East as commonage for cattle grazing (Wilken, pers. comm.), although the effect of historical large game such as Cape Buffalo *Syncerus caffer* (Raper and Boucher, 1988) may have been no different. Cape Parrots *P. robustus*, which rely primarily on yellow-wood fruits (Hockey et al., 2005), where known from the Boschberg in the late 1700s (Raper and Boucher, 1988). They are now extinct on the Boschberg (G. Brown, pers. comm.) but are still present in the Amatola forests to the east. This suggests a richer yellow-wood forest on the Boschberg in times past, although prior persecution by farmers is also a possible cause of local extinction.

Although both R.J. Gordon (in Raper and Boucher, 1988) and Le Vaillant (1790) noted the presence of valuable *Ocotea bullata* (Burch.) Baill. on the Boschberg, it was not mentioned by Sim (1907) as occurring in the area except for a few trees in the higher elevations of the Amatola Forests. (Sim, 1907, in fact did not mention the Boschberg in particular in his overview of the forests of the then Cape Colony). Even if *O. bullata* occurred on the Boschberg prior to European settlement its existence on the Boschberg today is doubtful.

Today the slopes of the Boschberg are probably in a state of regeneration, with young to medium-sized *A. falcatus* common in the dense ravine forests. The intervening spurs are currently dominated by dense *O. europaea* subsp. *africana* woodland-thicket, and this may be a pre-climax woodland-forest community to be replaced in time with *A. falcatus* and other typical forest species, or represents a stable woodland community as is typical elsewhere in the Sneeuberg (see Clark et al., 2009). It is possible, however, given the protection received since 1937, that the Boschberg Nature Reserve forests are in their best condition since ca. 1900 but are a far cry from the purported 15–30 m tall yellow-wood climax forest of times past.

Typical woody species in the Boschberg forests include *A. falcatus*, *Apodytes dimidiata*, *Calodendrum capense*, *Canthium ciliatum*, *C. mundianum*, *Carissa bispinosa*, *Cassinopsis illicifolia*, *Celtis africana*, *Cussonia spicata*, *Dovyalis zeyheri*, *Ficus burtt-davyii*, *Grewia occidentalis*, *Halleria lucida*, *Heteromorpha arborescens* var. *arborescens* (interior form), *Maytenus acuminata*, *M. undata*, *Mimusops obovata*, *Mystroxylon aethiopicum*, *Olinia emarginata* (often in pure stands on both the Boschberg and Groot-Bruintjieshoogde), *Pittosporum viridiflorum*, *Pterocelastrus tricuspidatus*, *Rapanea melanophloeos*, *Rhamnus prinoides*, *Rhoicissus revoili*, *R. tridentata*, *Scolopia mundii*, *Searsia chiridensis*, *S. dentata*, *S. pyroides* and *Xanthoxylem capense*. The understory comprises species such as *Asparagus declinatus*, *Behnia reticulata*, *Dietes grandiflora*, *Disperis lindleyana*, *Lauridia tetragona*, *Oplismenus hirtellus* and *Plectranthus laxiflorus*. Ferns are abundant, particularly along watercourses, and include *Asplenium aethiopicum*, *A. monanthes*, *Blechnum attenuatum* var. *attenuatum*, *Cystopteris fragilis*, *Dryopteris inaequalis*, *Thelypterus guienziana* and *T. pozoi*. *Freesia laxa* and *Hermannia violacea* (a Great Winterberg–Amatola and Boschberg endemic) are common on forest margins.

4.3. Albany thickets

Eastern Cape Escarpment Thicket (Mucina and Rutherford, 2006) dominates much of the Boschberg Escarpment, intergrading with Southern Mistbelt Forest as mentioned above. This vegetation unit occurs patchily along the southern Great Escarpment from Somerset East to Hogsback (Mucina and Rutherford, 2006). Typical species are *A. karroo*, *Azima tetracantha*, *Capparis sepiaria*, *Ehretia rigida*, *Euclea crispa* subsp. *crispa*, *E. undulata*, *Euphorbia tetragona*, *Gymnosporia buxifolia*, *Hippobromus pauciflorus*, *Pappea capensis*, *Portulacaria afra*, *Pteroxylon obliquum*, *Schotia latifolia*, *Scutia myrtina*, *Searsia pallens*, *Vepris lanceolata* and *Ziziphus mucronata*. In some places *A. karroo* is almost completely dominant (such as at the base of the Boschberg in the Boschberg Nature Reserve) while in other places *E. tetragona* is more typically dominant (such on the east-facing slopes of the Glen Avon Falls valley).

Great Fish Thicket occurs along the Little Fish River between the Boschberg and the Groot-Bruintjieshoogde, as well as along the Great Fish River (Clark et al., 2009; Mucina and Rutherford, 2006). This is a much more arid thicket vegetation unit and is characteristic of much of the Albany Centre of Plant Endemism (Mucina and Rutherford, 2006). Typical trees include *A. karroo*, *Boschia oleoides*, *Euclea undulata* and *Olea europaea* subsp. *africana*, while the bulb *Drimia altissima* is abundant and very conspicuous in early summer after rains. The invasive shrub *Nicotiana glauca* is common and is a potential problem in this vegetation type along watercourses. Camdeboo Escarpment Thicket, the typical Sneeuberg Escarpment thicket vegetation unit, occurs on the western slopes of the Groot-Bruintjieshoogde (Mucina and Rutherford, 2006) and is detailed by Clark et al. (2009).

4.4. Noteworthy localised vegetation types

Although not common on the Boschberg, *Pteridium aquilinum* subsp. *aquilinum–Rubus rigidus* ("bracken-briar") thickets are worthy of mention simply because it is a typical Afromontane community characteristic of the moister eastern Great Escarpment in southern Africa but absent from the Sneeuberg except on the Boschberg. A bracken-brier patch of about 1 ha occurs on the Farm Glen Avon and consists of a dense community of *Clutia pulchella, Euclea coriacea, Garuleum tanacetifolium, Hermannia violacea, Indigofera cuneifolia, Lauridia tetragona, Pelargonium grossularioides, Phylica paniculata, Printzia pyrifolia, Psoralea glabra, Pteridium aquilinum subsp. aquilinum, Rubus rigidus* and *Searsia tomentosa*. It is situated in a south-east-facing bowl on the Boschberg Escarpment edge and receives an abundant supply of moisture from groundwater seepage, mist and rain.

Wetland vegetation is confined to the edges of local dams, natural pools along rivers, and stream- and river-lines. Species typical of open habitats (dam fringes and summit streams) include *Cliffortia paucistaminea*, *Denekia capensis*, *Merxmuellera macowanii*, *Paspalum dilatatum* (alien), *Senecio polyodon* subsp. *polyodon*, and numerous Cyperaceae and Juncaceae. The riparian vegetation of the Naudesrivier downstream of Glen Avon Falls is characterised by *Cliffortia strobolifera*, *Cotula nigellifolia*, *Cyperus textilis*, *Moraea huttonii*, *Salix mucronata*, and the grasses *Holcus lanatus* and *Panicum deustum*.

Another important type of community is found on south- and south-east-facing cliffs. These moist cliff-lines host cushions of *Anthospermum pumilum* subsp. *rigidum*, *Asplenium adiantum-nigrum* var. *adiantum-nigrum*, *A. trichomanes* subsp. *quadrivalens*, *Crassula cultrata*, *C. montana* subsp. *quadrivalens*, *C. setulosa* var. *setulosa*, *Delosperma lootsbergense*, *Galium thunbergianum* subsp. *hirsutum*, *Lepisorus schraderi*, *Nemesia* cf. *rupicola* (specimens sent to K. Steiner), *Othonna carnosa*, *Pentaschistis airoides* subsp. *jugorum*, *Pleopeltis macrocarpa*, *Polypodium vulgare*, *Streptocarpus meyeri* and *Troglophyton capillaceum* subsp. *diffusum*. Cliff-bases host *Cineraria erodioides* var. *erodioides*, *Conium* sp. no. 3, *Polystichum monticola*, *Stachys grandifolia* and *Rumex cordatus*, and various wooded communities such as *Buddleja salviifolia–Kiggelaria africana* thicket, or more mesic thicket and forest types as discussed above.

5. Flora of the Boschberg and Groot-Bruintjieshoogde

5.1. Fieldwork and specimen handling

Two comprehensive collecting trips were undertaken in November and December 2008 to the Boschberg and Groot-Bruintjieshoogde, followed by two shorter trips in May and June 2010 (Table 1). A total of 977 specimens were collected. This data has been augmented with data collected by Cameron McMaster since 1973 (mostly photographic) and historical collections by Harry Bolus and Peter MacOwan housed in GRA. The identification of the collected specimens was undertaken in the Selmar Schönland Herbarium (GRA), in the Albany Museum, Grahamstown. Pressed specimens and photographic specimens have been lodged in GRA, with duplicates of various groups from the pressed specimens sent primarily to BLFU, BOL, Buffelskloof, J, JRAU, K, MO, NBG, NU, PRE, S, and STEU. The flora of the Boschberg is contained in Appendix A. This flora has also been merged with that published for the Sneeuberg by Clark et al. (2009), and the updated complete flora for the Sneeuberg mountain complex is available online on the Selmar Schönland Herbarium website at http://campus.ru.ac.za/index.php?action=category&category=2061.

5.2. Phytogeographical considerations

Although considered by Clark et al. (2009) to be part of the Sneeuberg mountain complex, the vegetation of the Boschberg and Groot-Bruintjieshoogde (but particularly of the Boschberg) differs significantly from the rest of the Sneeuberg in terms of species composition and vegetation units. Of the rest of the Sneeuberg, only the Kamdebooberge approaches the Boschberg and Groot-Bruintjieshoogde in this regard, and all three montane components host species not found elsewhere in the Sneeuberg. This may be due to their orientation, which is well-situated to harvest moisture from south-easterlies, compared to the more arid interior Sneeuberg (Clark et al., 2009). This moisture availability perhaps compensates for their relatively low altitude. Thus the Boschberg and Kamdebooberge are "tail-ends" spurs off the eastern and western ends of the Sneeuberg respectively, providing high local endemism and diversity in the Sneeuberg Centre.

5.3. Flora and significant findings

A flora of 656 taxa has been compiled (Appendix A), although this probably only represents about 60–70% of the absolute total for the Boschberg and Groot-Bruintjieshoogde. Not many significant finds were forthcoming, but do include *Aspalathus* cf. *katbergensis* from the Boschberg Nature Reserve, a species previously considered endemic to the Great Winterberg-Katberg (Dahlgren, 1988); collections of the poorly collected near-endemic *Garuleum tanacetifolium*; additional material of the recently discovered Boschberg endemic *Hermannia crassifolia* (Clark et al., 2009; Gwynne-Evans, pers. comm.); and large populations of *Albuca tenuifolia* on the summit, described by Baker (1872) without precise locality and now known to occur

Table 1
Collecting trips to the Boschberg and Groot-Bruintjieshoogde (2008 and 2010), Somerset East District.

Localities	Dates	Collectors	Grids
1. Boschberg Nature Reserve and Boschberg	November 2008	Clark VR, Andrews A; Clark VR, Coombs G	3225DA
2. Boschberg Nature Reserve, Boschberg and Groot-Bruintjieshoogde	December 2008	Clark VR, Daniels RJ, Le Roux JA, Fabricius M	3225AD, CB, DA
3. Boschberg Nature Reserve	May 2010	Clark VR, Martínez-Azorín M	3225DA
4. Boschberg Nature Reserve and Boschberg	June 2010	Clark VR, Martínez-Azorín M	3225DA

across the Sneeuberg mountain complex from the Boschberg to the Koudeveldberge (Martínez-Azorín et al., in prep.). Despite an intensive search, *Diascia ramosa*, endemic to the forests on the Boschberg and only known from two specimens collected in the later 1800s (Hilliard and Burtt, 1984), was not rediscovered.

5.4. The Boschberg and Groot-Bruintjieshoogde: floristic "hub" of the southern Great Escarpment

The species composition and vegetation units of Boschberg and Groot-Bruintjieshoogde are more typical of the Great Winterberg–Amatolas than of the Sneeuberg (e.g. Mucina and Rutherford, 2006), although there is a clear gradation along the Groot-Bruintjieshoogde from Boschberg-type vegetation to Sneeuberg-type vegetation (e.g. Mucina and Rutherford, 2006). These differences can be attributed to a climate gradient, suggesting that the vegetation units and species distributions on the southern Great Escarpment are largely climate-driven, as southern Great Escarpment geology is consistent from the Great Winterberg to the Roggeveld (i.e. Beaufort Group sediments intruded by dolerites). The Great Winterberg has a mean annual precipitation (MAP) of at least 1000 mm per annum on the windward Great Escarpment crest (Scott, pers. comm.), as does the Boschberg (G. Brown, pers. comm.; Wilken pers. comm.), whereas the wettest components of the Sneeuberg only have a MAP of about 700 mm (Clark et al., 2009).

Of particular interest are the several plant species endemic to the Great Winterberg–Amatolas and which also occur on the Boschberg (Clark et al., 2009). The reverse is true, with the recent discovery of the previously considered Sneeuberg endemic *Bergeranthus nanus* (Clark et al., 2009) on the Great Winterberg (unpublished data). Similarly, the interval does not appear to have been a serious barrier to a host of moist eastern and southern species (*Afrocarpus falcatus*, *Cyrtanthus tuckii*, *Deneckia capensis*, and *Peperomia retusa*, to name a few). Connectivity between the Sneeuberg-proper and Great Winterberg–Amatolas is supported by *Erica* aff. *reenensis* on the Nardousberg (Clark et al., 2009), and recently recorded on the Great Winterberg (unpublished data), and *Delosperma* sp. nov. aff. *dyeri* from the Nardousberg (Clark et al., 2009) either being sympatric with the Great Winterberg-endemic *D. dyeri* (Dold and Hammer, 2001), or conspecific with it (Burgoyne, pers. comm.). *Garuleum tanacetifolium*, previously only known from the Kagaberg (behind Bedford) and the Boschberg, is now known from the Sneeuberg as far west as the Nardousberg where it is very common on south-facing mountain slopes above 1800 m (unpublished data). This suggests that the Great Fish River Interval of Clark et al. (2009) is not a major hindrance to connectivity along this region of the Great Escarpment, and lends support to Nordenstam (1969) and Hilliard's (1994) "Sneeuwbergen" phytogeographical centre. This centre circumscribes the Sneeuberg together with the Great Winterberg–Amatolas and Stormberg, and brings into question the validity of a separate Sneeuberg Centre of Endemism as proposed by Clark et al. (2009). An alternative is to simply lump all these fragmented sections of Great Escarpment into an extended DAC as proposed by Mucina and Rutherford (2006) and contemplated by Clark et al. (2009). The difficulty in this regard is that despite many similarities between these sections of the Great Escarpment, there is enough local endemism (probably at least 2% in each; unpublished data) to tempt delimitation of separate Sneeuberg, Great Winterberg–Amatola and Stormberg Centres of Endemism (the Stormberg still requires a detailed floristic study, but available evidence indicates significant local endemism). It will probably never be possible to completely resolve this biogeographically complicated montane scenario, but nevertheless it should be acknowledged that these (still poorly known) sections of Great Escarpment are rich in localised endemics – even the well-connected Boschberg has some local endemics and local variants of more widespread eastern species – and therefore warrant further detailed botanical investigation and appropriate conservation measures.

5.5. The Boschberg and Groot-Bruintjieshoogde: floristic "hub" between the southern Great Escarpment and the CFR

The possibility exists that the Boschberg is a significant link between the CFR and the Great Escarpment in southern Africa. The 60 km of relatively high ground between the Zuurberg and the Boschberg could easily account for the presence of numerous fynbos species found on the Boschberg, and perhaps account for the current disjunction of several others known from the DAC and CFR (Weimarck, 1941). This connection, representing Weimarck's (1941) south-eastern connection, may thus account for a high proportion of the genetic traffic between the CFR and eastern Great Escarpment. It may also be the route that was used for the now sympatric species of *Chaetops* (Rockjumpers), *Promerops* (Sugarbirds) and *Pseudochloroptila* (Siskens) now endemic to the CFR and DAC/eastern Great Escarpment (Clark et al., 2009; Hockey et al., 2005), as well as for the host of species that occur from the CFR up through the eastern Great Escarpment (and for some, northwards into the tropical African mountains).

6. Conclusion

The Boschberg and Groot-Bruintjieshoogde have a rich flora and are floristically closely related to the Great Winterberg–Amatolas, sharing four endemics and a large number of moist eastern taxa not found on the main Sneeuberg. Such evidence of connectivity suggests that the Great Fish River Interval is a minor phytogeographical interval. The presence of such species on the Boschberg and Groot-Bruintjieshoogde but not further west on the same (continuous) Sneeuberg suggests that the distribution of species on the southern Great Escarpment is also due to climate filtering and not simply disjunction. Disjunction thus plays a minor role in the distribution of many Great Escarpment species.

Our data confirm that the Boschberg forms part of the south-eastern connection between the CFR and the Afromontane region in southern Africa, a connection first suggested by Weimarck (1941). This link then is the main link between the CFR and the Afromontane region on the eastern Great Escarpment in southern Africa. The Boschberg is thus a node in the hub between the drier main Sneeuberg in the west, the Great Winterberg–Amatolas to the east, and the CFR to the south and south-west.

Acknowledgements

Chris Wilken (Somerset East Development Agency) kindly organised permissions and accommodation in the Boschberg Nature Reserve. Ros Turner (Blue Crane Tourism) was exceptionally helpful with information and recommendations. Bill and Alison Brown, and Greg and Fiona Brown (Glen Avon), Philip Erasmus (Charlton), Reg Playdon (Avon Heights), Danie Erasmus (Grootfontein), Dave Hobson (Struishoek), Fickie Fick (Waterkloof), Bennie du Randt (Wilgerfontein), Zirk and Anel Jordaan (Rietfontein), Phillip Staples (Waterkloof) and Jannie du Plessis (Morgenson) are all deeply thanked for permissions to access their properties and for valuable local information. The identification and confirmation of numerous specimens were very kindly undertaken by Peter Linder (Restionaceae), John and Sandie Burrows (*Asparagus* and Pteridophytes), Robert McKenzie (*Arctotis* and *Berkheya*), Elizabeth Retief (Boraginaceae and Rubiaceae), Rodney Moffett (*Searsia*), Chris Whitehouse (*Cliffortia*), Pieter Winter (Apiaceae), Ted Oliver (*Erica* and Orchidaceae), Brian Schrire (*Indigofera*), Graham Duncan (petaloid monocots), Dee Snijman (petaloid monocots), Dave Gwynne-Evans (*Hermannia*), Berit Gehrke (*Alchemilla* and *Carex*), Priscilla Burgoyne (Mesembryanthemaceae), Bruce Bayer (*Haworthia*), John Manning (petaloid monocots), Lyn Fish (Poaceae), Chris Cupido (Campanulaceae), Pieter Winter (Apiaceae), Kevin Balkwill (Polygalaceae) and Yashica Singh (*Hypoxis*). These taxonomists' generous help is much very much appreciated. This paper emanates from a PhD, the financial viability of which was made possible by the National Research Foundation (NRF) in the form of Grant GUN 2069059, a free-standing South African Biosystematics Initiative (SABI) grant, Buk'Indalo Consultancy cc (Durban), the National Geographic Society and the Cape Tercentenary Foundation. Tony Dold, Curator of the Selmar Schönland Herbarium (GRA), kindly provided working and specimen storage space for the duration of the project. Able and enjoyable field assistance was supplied by Chris Kelly, Gareth Coombs, Tony Andrews, Ryan Daniels, Jethro Le Roux and Mike Fabricius. Ashley-Kate Davidson, Tellula Habib, Thomas King, Liziwe Nkwinti, Fikile Phaliso and Carl Cloete have provided invaluable administrative assistance in the Selmar Schönland Herbarium. Garreth Keevey's regular and cheerfully patient help with computer graphics is very much appreciated. Lastly, the first author would like to thank the Lord for protection and for the enjoyable, productive fieldtrips.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.sajb.2010.06.005.

References

Agricultural Research Council, 2006. http://www.arc.agric.za/home.asp?PID=1041&ToolID=63&ItemID=2986.
Baker, J.G., 1872. *Albuca tenuifolia*. In: Saunders, W.W. (Ed.), *Refugium botanicum* 5. Van Voorst, London, p. 335.
Bergh, J.S., Visagie, J.C., 1985. The Eastern Cape Frontier Zone 1660–1980. Butterworths, Durban.
Boerdery in S.A., 1965. September 1965, 9–11.
Bromilow, C., 1996. Probleem plante van Suid-Afrika. Briza, Arcadia.
Brown, B., Personal Communication. Farm Glen Avon, Somerset East District.
Brown, G., Personal Communication. Farm Glen Avon, Somerset East District.
Burgoyne, P., Personal Communication. Senior Scientist, South African National Biodiversity Institute, Pretoria.
Centre for Scientific and Industrial Research (CSIR), 2009. Satellite imagery of South Africa. Complimentary CD.
Clark, V.R., Barker, N.P., Mucina, L., 2009. The Sneeuberg: a new centre of floristic endemism on the Great Escarpment, South Africa. South African Journal of Botany 75, 196–238.
Dahlgren, R., 1988. Flora of Southern Africa, Vol. 16, Fabaceae, Part 3, Papilionoideae, Fascicle 6, Crotalarieae (*Aspalathus*). Botanical Research Institute, Department of Agriculture and Water Supply.
Dold, T., Hammer, S., 2001. Dyer's *Delosperma* rediscovered. Cactus and Succulent Journal 73, 73–75.
Dold, T., McMaster, C., 2005. *Kniphofia acraea*: A rare red-hot poker revisited. Cactus and Succulent Journal 77, 190–193.
Galley, C., Bytebier, B., Bellstedt, D.U., Linder, H.P., 2007. The Cape element in the Afrotemperate flora: from Cape to Cairo? Proceedings of the Royal Society 27, 535–543.
Gunn, M., Codd, L.E., 1981. Botanical exploration of Southern Africa. Balkema, Cape Town.
Gwynne-Evans, D., Personal Communication. Department of Botany, University of Cape Town, Rondebosch.
Henderson, L., 2001. Alien Weeds and Invasive Plants. Plant Protection Research Institute Handbook No. 12. Plant Protection Research Institute, Agricultural Research Council, Pretoria.
Hilliard, O.M., 1994. The Manuleae: a Tribe of Scrophulariaceae. Edinburgh University Press, Edinburgh.
Hilliard, O.M., Burtt, B.L., 1984. A revision of *Diascia* section *Racemosae*. Journal of South African Botany 50, 269–340.
Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (Eds.), 2005. Roberts — Birds of Southern Africa, VIIth Ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.
Le Vaillant, F., 1790. Travels into the Interior Parts of Africa by way of the Cape of Good Hope. Vol. 1. Van Riebeck Society, Paarl.
Martínez-Azorín, M., Clark, V.R., Crespo, M.B., Dold, A.P., Barker, N.P., 2010. The rediscovery of *Albuca tenuifolia* Baker. (In prep).

McMaster, C., 2007a. A very grand flower: *Dierama grandiflorum*, pp. 29–31. Veld and Flora.
McMaster, C., 2007b. *Disa lugens*. New discoveries in the Eastern Cape extend the known range of this wonderful orchid, pp. 147–149. Veld and Flora September 2007.
McMaster, C., 2009. The Waainek Wild Flower Reserve, pp. 92–93. Farmer's Weekly January 2009.
Mucina, L., Rutherford, M.C. (Eds.), 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia. South African National Biodiversity Institute, Pretoria. Vol. 19.
Nordenstam, B., 1969. Phytogeography of the genus *Euryops* (Compositae). A contribution to the phytogeography of Southern Africa. Opera Botanica 23, 7–77.
Raper, P.E., Boucher, M., 1988. In: Gordon, R.J. (Ed.), Cape Travels. Brenthurst, Johannesburg, pp. 1777–1786. 2 Vols, 1st Ed.
Rebelo, T., 2001. *Proteas*: a field guide to the Proteas of Southern Africa. Fernwood Press, Vlaeberg.
Scott, D., Personal Communication. Farm The Hoek, Great Winterberg, Adelaide District.
Sim, T.R., 1907. The Forests and Forest Flora of the Colony of the Cape of Good Hope. Taylor & Henderson, Aberdeen.
Somerset East Municipality, sine anno. Bosberg Nature Reserve. Information Brochure.
Somerset East Transitional Council, sine anno. Bosberg Nature Reserve. Information Brochure.
Staples, P., Personal Communication. Farm Waterkloof, Groot-Bruintjie-shoogde. Somerset East District.
Story, R., 1952a. A Botanical Survey of the Keiskammahoek District. Botanical Survey Memoir No. 27. Department of Agriculture, Division of Botany.
Story, R., 1952b. A botanical survey of the Keiskammahoek District. In: Mountain, E.D. (Ed.), The Natural History of the Keiskammahoek District. Keiskammahoek Rural Survey Vol. 1. Shuter & Shooter, Pietermaritzburg, pp. 42–54.
Sugden, J.M., 1989. Late Quaternary palaeoecology of the central and marginal uplands of the Karoo, South Africa. Unpublished PhD Thesis, Department of Environmental and Geographical Science, University of Cape Town.
Van der Walt, P.T., 1972. 'n Plantekologiese plantopname van Boschberg en sy omringende gebiede met speciale verwysing na die weidingsfaktor. Unpublished PhD Thesis, Faculty of Natural Science, University of Natal, Pietermaritzburg.
Walker, E.A., 1936. The Cambridge History of the British Empire, Vol. 8. Cambridge University, Cambridge.
Weimarck, H., 1941. Phytogeographical Groups, Centres and Intervals Within the Cape Flora. Lund, Leipzig.
White, F., 1983. The Vegetation of Africa. A Descriptive Memoir to Accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa. Natural Resources Research 20. UNESCO, Paris.
Wilken, C., Personal Communication. Blue Crane Development Agency, Somerset East.

Edited by JC Manning