What is Renosterveld?

Grassy-shrubland or shrubby-grassland? Have recent analyses of soil carbon isotopes provided an answer?

by **Odette Curtis**, Director: Overberg Lowlands Conservation Trust and **William Bond,** University of Cape Town

ABOVE: Renosterveld occurs in several forms in the Overberg, in this case, as a C_4 grass-dominated habitat, rich in bulbs. These types of habitat structures are especially prevalent for the first few years after fire. Photo: Odette Curtis.

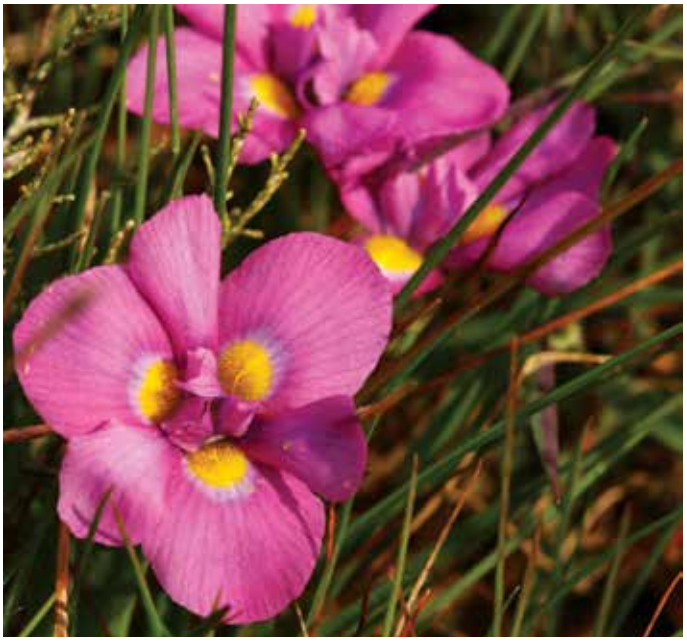
"The debate about what 'pristine' renosterveld should consist of will no doubt continue indefinitely." (Ian Newton 2008)

The two Old World Mediterranean-type climate regions that contain the oldest records of human habitation are the Mediterranean region itself and the Cape region of South Africa. These regions have been occupied for hundreds of millennia, while their New World counterparts in California, Chile and Australia have only been populated by humans for tens of millennia. However, across the globe, *Homo sapiens* has been influencing the structure of landscapes and manipulating processes in order to get the maximum resources out of the system. Thus, humans have evolved from being hunter-gatherers to domesticating livestock, to manipulating natural pastures for improved grazing, to becoming more sedentary due to the development of small-scale agriculture, and finally, to developing large-scale, commercial agriculture with the aid of machinery and technology. However, in many cases across the globe, land transformation associated with human 'development' has occurred at such a rapid rate that there are very few accounts or descriptions of what these landscapes looked like before the advent of large-scale commercial agriculture. Naturally, this presents several challenges; one of which is an ecological understanding of the systems we are attempting to conserve, so that we might make informed management decisions.

This is especially true for renosterveld, a severely fragmented habitat occurring in an exceptionally diverse landscape. Lowland renosterveld often has a uniform grey appearance due to the dominance of small-leaved asteraceous shrubs, which creates the illusion of a homogeneous habitat with low diversity. This, however, is not the case: renosterveld is one of the richest plant assemblages on earth per unit of land area. It can also be grassier and tends to be richer in plant diversity than the adjacent fynbos habitats. Lowland renosterveld types essentially occur in the Western Cape and are most renowned for their exceptionally high levels of geophytic diversity. The types are broadly divided into West Coast Renosterveld (the shale-derived lowlands of the 'Swartland'/west coast of the Western Cape) and South Coast Renosterveld (the shale-derived lowlands of the southern and south-eastern Cape), with several unique vegetation types falling into these two broad categories. West Coast and South Coast Renosterveld are very different systems with, for example, South Coast Renosterveld being more fertile and, particularly in the eastern-most extent of its range, receiving more summer rain and thus containing a higher proportion of palatable (C_4) grasses. Both West Coast and South Coast Renosterveld have been severely transformed, with more than 90% of the original extent ploughed for agricultural development, rendering most types Critically Endangered and highly prone to functional extinction.

The name 'renosterveld' is derived from the Afrikaans words 'renoster' (meaning rhino) and 'veld' (meaning vegetation), although the exact reasons for this choice of name are unclear. It is generally believed that the vegetation was named after the Black Rhino which occurred in the Western Cape, due to the fact that either the overall uniform 'grey' appearance of the vegetation resembled that of a rhino hide, or that the rhinos occurred in this vegetation.

The viability of lowland renosterveld as a functioning ecosystem is influenced by a suite of factors, from those occurring as a result of substantial shifts in management regimes to those caused by significant fragmentation and habitat loss. Renosterveld management is particularly challenging because, despite the fact that this vegetation type falls within a biome that is fairly well-studied, there is disagreement among ecologists about what renosterveld actually *was* (and thus what we are managing *for*). The suggestion that current-day renosterveld does not resemble the renosterveld communities prior to major landscape transformation, post European settlers, has been debated for several decades with no definitive conclusions being reached.

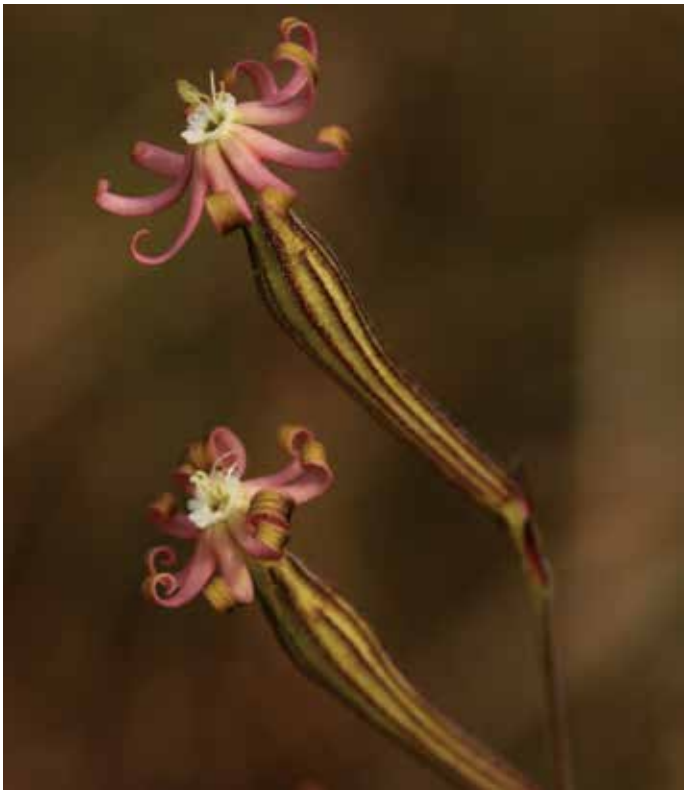


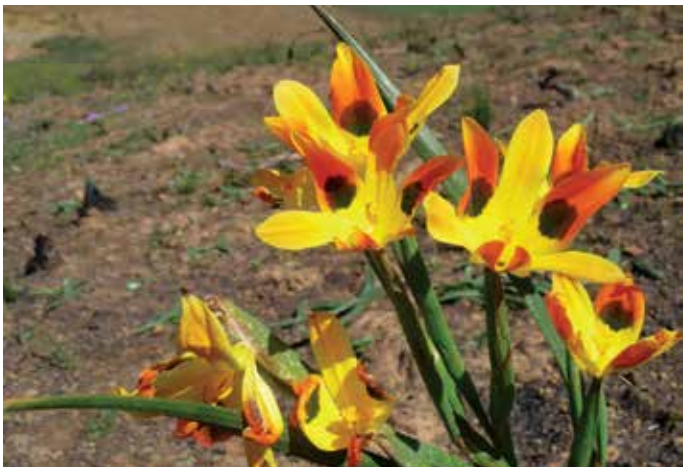
TOP: C_3-dominated renosterveld in the Overberg, dominated by *Oedera squarrosa* and C_3 grasses (*Pentaschistis eriostoma*). Photo: Odette Curtis.
LEFT: The Endangered *Moraea tricolor*. Photo: Odette Curtis.
ABOVE: *Tritonia deusta*. Not rare or threatened, but an absolute gem. Photo: Odette Curtis.

What is the big debate and how is it relevant to renosterveld conservation?

Nearly three decades ago, Richard Cowling proposed the hypothesis that South Coast Renosterveld was historically dominated by *Themeda triandra* and that Asteraceous shrubs (particularly *Elytropappus* and *Metalasia* species) had started to dominate the landscape as a result of severe overgrazing by domestic livestock. In support of this hypothesis, Ian Newton and Richard Knight suggested that, since the intensification of the use of domestic livestock by Europeans in the Western Cape about 200 years ago, renosterveld has been severely transformed, essentially changing the system from a 'shrubby grassland' to a 'grassy shrubland'. They hypothesized that two main factors contributed to this: the large-scale extermination of indigenous grazing and browsing herbivores and the introduction of selective grazers in the form of sheep and cattle. In other words, the replacement of a suite of herbivores of different sizes and varying grazing and browsing preferences with two highly selective grazers (domestic sheep and cattle) resulting in a shift from a system where grasses were prominent (if not dominant), to a system generally dominated by unpalatable, asteraceous shrubs. An alternative hypothesis is that renosterveld was always a shrubland dominated by asteraceous shrubs (particularly *Elytropappus*), as it is today.

Several historical statements have been cited as anecdotal evidence that a shift from Poaceae to Asteraceae took place in the Western Cape's lowlands and that this shift occurred in the last two centuries. In 1785, Sparrman published on what he saw as the demise of the South Coast grasslands and the resultant increase in *Elytropappus*, stating, 'it is not at all unlikely that future ages may see this part of Africa entirely changed and different from what it is at present'. In 1943, Smit made reference to the lowlands of the South Coast once being known as the 'blue grassveld', presumably in reference to the dominance of *Themeda* (commonly known as 'red-' or 'blue-grass', due to the hue created by extensive areas of this species). However, *Ehrharta* (an important palatable C_3 grass) is also known as 'blue grass',





ABOVE: *Silene pilosellifolia* subsp. *pilosellifolia*. Photo: Odette Curtis.
TOP RIGHT: *Gladiolus vandermerwei*, an endangered bulb species. Photo: Odette Curtis.
RIGHT: *Moraea elegans*, an endangered bulb species. Photo: Odette Curtis.

thus these accounts may also have been referring to this species. In her 1929 paper on 'The problem of the Renoster-Bush', Margaret Levyns described the Renosterbos as a potential 'problem plant' and noted, with reference to renosterveld: 'Although the renoster bush is its principle constituent, several shrubs and other composites, and many geophytes are associated with it. However, these do not break the grey-green monotony of this type of plant community.' Nearly 30 years later, Levyns (1956) attributed overgrazing as the likely cause for what she viewed as the spread of *Elytropappus* and drew attention to the fact that farmers were burning renosterveld in order to utilize the re-growth for grazing, but that in the long-term, this management policy 'only perpetuates' *Elytropappus*. Several other historic accounts describing the flora of the Cape suggest the existence of a grassier lowland system than what is present today, as well as an increase in the spread of renosterbos, due to man-induced influences on the landscape.

These accounts may suggest that the lowlands of the Cape were richer in palatable grasses prior to the arrival of the settlers and that today's landscape is the result of several decades of mismanagement. Alternatively, these observations were biased against unpalatable shrubs and saw the grasses as pristine and worth promoting for grazing. However, the European settlers (having first arrived in the 1650s) were not the first pastoralists tending livestock in the region. The Khoi-Khoi had been present in the area for 2000 years prior to the arrival of the settlers and were already manipulating the vegetation through frequent burning to provide fodder for livestock. It is surmised that the Khoi people were responsible for converting renosterveld from a shrubland into a grassland system to promote feed for their livestock. Thus, the argument goes, renosterveld *was* in fact a shrubland prior to habitat manipulation by the Khoi-Khoi. This hypothesis also has merit. However, if the Khoi were regularly burning renosterveld and using the fresh new growth for grazing their cattle immediately these became available, they too might have damaged the grass component and encouraged the spread of asteraceous species, as this is far more likely to occur when renosterveld is continually burned and grazed, with no rest periods. If, however, the nomadic Khoi people burned extensive areas while moving through with their livestock, they may well have allowed the veld significant periods of rest and so increased, or at least, maintained, the grass component.

Using carbon isotopes to assess vegetation change

The stable carbon isotope method exploits the differences in photosynthetic pathways in different plants, as these are detectable in the Delta-13-Carbon ($\delta^{13}C$) values in the plant material itself. Thus, because the $\delta^{13}C$-values of C_4 and C_3 plants are very distinct, analyses of these components in plants can be used to indicate a species preferred photosynthetic pathway. C_4 species have a value of -12 to -14‰ and C_3 species have values of -26 to -30‰, while values between -14 and -26‰ are suggestive of a mixed C_3-C_4 habitat. C_4 photosynthesis is common in tropical and subtropical grasses while most other plant species follow the C_3 pathway. These measurements of soil isotopic carbon have been used to test hypotheses regarding recent shifts in vegetation communities across the globe, as well as in fynbos systems. The method works on the premise that, because soil organic matter is derived from plant litter, the isotopic composition of soil will reflect that of the vegetation from which it stemmed. It is also assumed that present-day or more recent vegetation will be reflected in the upper parts of the soil profile, while samples from deeper in the profile will retain the carbon signature of historic vegetation cover.

In this study, we used stable isotope analysis of soil carbon to test the hypothesis that historically, renosterveld comprised a higher C_4 grass component than is seen today and that not all renosterveld, at all times, was dominated by C_3 shrubs and grasses. We sampled soils in the Overberg from diverse landscape positions and as far west as Caledon and east to Swellendam/Heidelberg. We assumed that deeper soil layers stored older carbon than the surface soil layers.

What we found and what this means for management

The results of our carbon analyses suggest that C_3 grasses and shrubs are more prevalent in renosterveld than C_4 grasses and that renosterveld generally comprises a mixture of C_3 and C_4 shrubs and grasses. The results also confirm that renosterveld in the Overberg is unlikely to have been dominated by C_4 grasses

ABOVE: Like many renosterveld types, renosterveld in the Overberg can appear homogeneous at first glance when dominated by C_3 shrubs (in this case, *Elytropappus*) and grasses (*Merxmuellera*), but don't be fooled by this 'drab' appearance – renosterveld is also renowned for its incredible botanical diversity! Photo: Odette Curtis.

historically, except in small patches, and that managing for these grasses alone could severely alter the composition, diversity, and structure of this system. The slight increase in C_4 signal with increasing soil depth suggests the presence of more C_4 grasses in the past, consistent with being grazed out more recently. However, very few of the results suggested a pure C_4 (*Themeda*) grassland, suggesting that palatable C_3 grasses (such as *Ehrharta*) may have played an important role in sustaining large herds of grazing game. However, the soil study also confirmed the historic pattern of an increasing proportion of C_4 grasses along a west-east gradient, in line with current-day community structures of habitats along this gradient. It is known that C_4 grasses are far more prevalent in renosterveld systems much further east (e.g. around Humansdorp, beyond the scope of this study), where it is certainly likely that these have been reduced substantially through overgrazing over the last few centuries.

Most importantly, however, the results of this study, combined with experimental-burn plot data in parallel studies, confirm that renosterveld is not merely a degraded grassland invaded by asteraceous shrubs. Thus it would **not** be appropriate to burn renosterveld every three years, as suggested previously by some ecologists. Rather, renosterveld is likely to require burning frequencies similar to adjacent fynbos shrublands, but probably at longer fire return intervals since the drier renosterveld climate will cause fuels to accumulate at a slower rate.

Conservation and management in the Overberg

While research is a lot of fun and our academic minds are stimulated by tackling all these interesting and relevant questions, there is little point in acquiring knowledge about endangered habitats if this does not translate into conservation action. The plight of the Overberg's lowlands has been recognized for decades, yet very few conservation inroads have been made in the area until recently. In April 2012, the Overberg Lowlands Conservation Trust was initiated, in the hope that the conservation of these rapidly-eroding renosterveld habitats could be addressed. This new NGO (one year old in April 2013) is dedicated to the conservation of renosterveld and other threatened lowland habitats in the Overberg. The Trust aims to work with landowners and local communities to build partnerships which will ensure the long-term conservation and sustainable management of renosterveld fragments across the region. Please visit our website (www.overbergrenosterveld.org.za) for more details and watch this space for updates on this exciting venture.

ACKNOWLEDGEMENTS

Thank you to Tracey Nowell for overseeing and assisting with the lab processing and to Ian Newton for carrying out soil analyses timeously and for his very valuable inputs and discussions on this work. And the Mazda Wildlife Trust for providing a Mazda bakkie for the Overberg Lowlands Conservation Trust.

READING

Cowling, R. M., Pierce, S. M. & Moll, E. J. 1986. Conservation and utilization of South Coast Renosterveld, an endangered South African vegetation type. *Biological Conservation* 37, 363-377.

Newton, I.P. & Knight, R.S. 2004. The matrix: the evolutionary development of coastal renosterveld. *Veld & Flora* 90(4), 162-165.

Rebelo, A.G. 1995. Renosterveld: conservation and research. *In:* Low, A.B. & Jones, F.E. (eds). *The sustainable use and management of renosterveld remnants in the Cape Floristic Region: proceedings of a symposium:* 32-42. FCC report 1995/4. Flora Conservation Committee, Botanical Society of South Africa, Kirstenbosch, Cape Town.

WHAT DOES THAT MEAN

Asteraceous Belonging to the daisy family, Asteraceae.

C_3 and C_4 photosynthesis Plants make use of different photosynthetic pathways for producing their sustenance: the two most common pathways are known as C_3 photosynthesis and C_4 photosynthesis. In the case of renosterveld, abundant C_4 grasses include *Themeda triandra* and *Cymbopogon marginatus*, C_3 grasses include *Ehrharta calycina, Pentaschistis eriostoma* and *Merxmuellera stricta*, while most shrubs have a C_3 signature.

Diversity The degree of variation of life forms within a given ecosystem.

Geophytic Plants with underground stems like bulbs and tubers.

Isotope One of two or more atoms with the same atomic number but with different numbers of neutrons.

Poaceae Grass family.

GET CONNECTED

Dr OdetteCurtis can be contacted at info@overbergrenosterveld.org.za. The Overberg Lowlands Conservation Trust website can be found at **www.overbergrenosterveld.org.za.**