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# Restoring valuable spekboomveld using the international carbon market

## One of the biggest restoration trials in the Southern Hemisphere aims to re-establish badly degraded spekboomveld and investigate carbon-trading opportunities

Left: Flowering spekboom (A. Mills)

### Introduction

Think of the south-eastern Cape, South Africa, and an image that springs to mind is a stately kudu browsing gracefully in dense, tangled foliage. Or contented elephants in Addo Elephant National Park, placidly foraging on thorny branches and succulent leaves. The supporting vegetation is known as Thicket, (or more formally, the Subtropical Thicket Biome) which has its heartland near Addo, and is distributed as far as Riversdale in the west and the Great Fish River in the east. It is an ancient and complex vegetation type, expressed in different forms, ranging from low noorsveld at its inland margins, to the dense bush with emergent tree euphorbias and aloes characteristic of valley slopes. But what few are aware of is the extent of devastation of thicket vegetation wrought by poor farming practices.

Forms of thicket vegetation that have been especially ravaged by overgrazing in the past century, are those rich in spekboom or igwanishe, *Portulacaria afra*. There is evidence that even in the short space of a decade, heavy browsing, especially by mohair-producing angora goats, can convert dense shrubland into a desert-like state. Of some 16,000 square km formerly covered in spekboom-rich thicket, some 46% has undergone severe degradation and 34% moderate disturbance. Unfortunately, removing livestock and resting the veld does not lead to natural recovery of the vegetation, as seedling establishment is constrained by the exposed soil's temperature extremes and reduced water-holding capacity. Essentially, to restore this thicket type requires active intervention, which is what this article is about.

Degradation of thicket has negative socio-economic repercussions. Reductions in diversity, soil carbon, soil quality, and plant productivity all lead to lower livestock productivity (Mills and Fey, 2004; Mills *et al.*, 2007). Decreases in availability of wood, wild fruits and medicinal plants used by rural communities also result in lowered income – approximately $150 per annum per household – which is a significant amount for struggling rural people (Cocks and Wiersum, 2003).

Restoration is expensive, and the active restoration of thousands of hectares of formerly healthy thicket, rich in spekboom plants, appears at first sight to be unfeasible. But there is compelling scientific evidence that spekboom - with its rather special characteristics, together with the possibilities of earnings via the carbon market, and the creation of jobs in the economically depressed rural areas - may provide an all-round solution (Mills and Cowling, 2006; Mills *et al.*, 2007).

## How grazing affects spekboom

It is interesting that, although spekboomveld evolved under the grazing of hulking megaherbivores - elephant and black rhino - it is especially vulnerable to heavy grazing by goats. The explanation for this anomaly is that indigenous animals feed from above, promoting the natural umbrella-shaped canopy. In contrast, goats tend to feed from underneath, with the result that overgrazing destroys this canopy. With indigenous browsing, the shrub forms a 'skirt' of branches which are able to root and proliferate on contact with the ground, while broken branches are able to re-establish, much like planted cuttings. The theory is that the plant's unique umbrella-shaped canopy maintains a cool, drier microclimate conducive to accumulating carbon-rich ground litter, which may also explain the rates of carbon sequestration which are extraordinarily high for an arid environment (Mills and Cowling, 2006).

## Carbon storage in spekboom

Currently, there is an initiative which is building on the sound scientific evidence that spekboom is something of a 'superplant' when it comes to its extraordinary carbon storing capabilities. Data gathered over the last seven years show that carbon storage in intact spekboom thicket in the arid south-eastern Cape exceeds 20 kg of carbon per square metre of vegetation, which is equivalent to that of moist subtropical forests (Mills *et al.*, 2005; Mills *et al.*, 2005). In addition, the plant's ability to sprout from re-planted truncheons, without irrigation or cultivation in a nursery, makes it a very good candidate for large-scale restoration of degraded land. Furthermore, spekboom is thought to be especially efficient in capturing carbon as it is among those special arid plants which can switch from using the 'normal' photosynthetic pathway ($C_3$) to another water-conserving (CAM) pathway when conditions are dry. The ability to use the $C_3$ pathway when the soil is moist means it is more productive than those succulents that use only CAM.

Below: Mike Powell in front of a healthy stand of spekboom, *Portulacaria afra* (A. Mills)

The Restoration Research Group (R3G) is a group of scientists who are currently evaluating the feasibility of massive-scale restoration of thicket. Their project includes possibly one of the biggest restoration trials in the southern hemisphere. Spanning the entire Thicket Biome, a distance of about 800 km, this investigation aims to determine areas for 'optimal survivorship' and best growth from cuttings of the succulent-leaved shrub, spekboom, as well as variation in rates of carbon sequestration.

One aim of this trial is to determine the potential for re-planting to earn carbon credits on the international market as a future means of funding land restoration on freehold and communal land. R3G is working in close partnership with the Department of Water Affairs and Forestry's *Working for Woodlands* Project and supported by poverty-alleviation funds from the government's Expanded Public Works Project. The actual re-planting is being supervised by the Gamtoos Irrigation Board (GIB), the implementing agency which has been managing large-scale plantings over the last three years, restoring close to 400 ha in the Baviaanskloof Nature Reserve (a World Heritage Site), the Addo Elephant National Park and the Great Fish River Reserve.

Data on the remarkable rates of carbon storage under re-planted spekboom were collected on the farm Krompoort, between Uitenhage and Steytlerville, inland of Port Elizabeth. Over the last 30 years, the far-sighted farmer, Mr Henry Graham Slater, has systematically restored a degraded hillslope using spekboom truncheons. Now, the oldest spekboom plants stand more than 2 m tall and cover 90% of the planted site, an impressive growth from truncheons planted in bare ground under a rainfall of only 250-350 mm per year. The different-aged plantings enabled estimates of potential rates of carbon sequestration, with the oldest stand having sequestered 11 kg of carbon per square metre over 27 years, indicating an average rate of 0.42 kg of carbon per square metre per year (Mills and Cowling, 2006). This rate of carbon sequestration is comparable to many temperate and subtropical forests, and potential earnings through carbon credits are likely to rival forest-planting schemes.

## Impressive results

The biome-wide trial commenced in January 2008, and already more than 100 of the planned 300 plots have been established. Farmers have been keen to participate in allowing trial plots to be located on their land, and many are going ahead with their own plantings. The trial plots (50 x 50 m each) are located in degraded thicket, and each plot is fenced off and manually planted with spekboom truncheons by trained teams under the supervision of GIB. Increments in carbon (above and below ground) are then monitored to determine rates of carbon storage.

Preliminary observations suggest that as the productive and water-efficient spekboom shrubs establish sufficiently to shade the soil surface and produce litter, the quality of the soil starts improving. This enables other flora and fauna to re-establish, and biodiversity begins to return. There is still much scope for horticultural research within our project to increase the survivorship of cuttings and to determine effects of soil properties (both biological and inorganic) on growth rates. Botanic gardens are well positioned to play a role in this critical part of restoration projects. Our project would welcome collaboration on this front.

Concurrent with the field trials, R3G is investigating the complex requirements to qualify for carbon credits. Trade in carbon in afforestation and restoration operates via two main paths: the formal compliance market (controlled by the Clean Development Mechanism, an arrangement under the Kyoto Protocol), or via the informal, voluntary market (Bumpus and Liverman, 2008). The spekboom project may well be best

Left: Spekboom, *Portulacaria afra* (M. Powell)

suited to the latter market, which follows many of the formal procedures of the formal compliance market but relies on individuals who care about climate change, or else is dependent on those corporate companies with social responsibility programmes. The voluntary market also takes into account the sustainable development of rural livelihoods and benefits for biodiversity. A critical aspect for either market is accurate quantification of carbon stocks in landscapes before and after the restoration. These carbon stocks include carbon in soils, litter and biomass. In order to earn the carbon credits, auditors need to be contracted to validate the project and certify that the carbon quantification is scientifically rigorous. This adds large transaction costs to a restoration project aiming to earn carbon credits and a rule of thumb is that any project less than 10,000 hectares is unlikely to earn sufficient credits to warrant the transaction costs. Seeing projects of this size implemented across the Eastern Cape is the ultimate goal of the Working for Woodlands programme. Green investors who back the carbon market are, however, at this stage still required to make this vision a reality.

Ultimately the potential benefits of restoration to degraded thicket landscapes are enormous from an environmental, social and economic perspective, leading to: increased wildlife carrying capacity, reduced soil erosion, improved water retention and infiltration in the soil, and the return of biodiversity, while earning carbon credits on international markets which can provide employment and income to rural communities. Surely a win-win-win situation!

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*R3G –the Restoration Research Group - comprises a group of scientists whose strength lies in a unique partnership, applying their scientific expertise with the practical implementation of the South African Government's Department of Water Affairs and Forestry's *Working for Woodlands* Project, which trains and employs contracting teams funded by the Expanded Public Works Programme (EPWP) under the supervision of the Gamtoos Irrigation Board. The scientists are based at Rhodes University, Stellenbosch University and Nelson Mandela Metropolitan University. See www.r3g.co.za.

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Left:
A restored slope (foreground) (A. Mills)