Survivorship of spekboom (*Portulacaria afra*) planted within the Subtropical Thicket Restoration Programme

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Through the Subtropical Thicket Restoration Programme (STRP), about 21.5 million cuttings of spekboom (*Portulacaria afra*) were planted over the period 2004–2016 in the Addo Elephant National Park, Great Fish River Nature Reserve and the Baviaanskloof Nature Reserve. This planting includes a large experiment of 330 quarter-hectare plots in which 14 different planting treatments were used.[1] These experimental plots, known as the 'thicket-wide plots', comprised 200 000 cuttings, with the remaining 21.3 million cuttings planted out in what were called the 'large-scale plantings'. Some of the large-scale plantings were replanted with cuttings – a procedure referred to as blanking. The positioning and number of cuttings used in each blanking operation was not recorded and consequently the surviving cuttings in any particular landscape within the large-scale plantings cannot be aged accurately. Notwithstanding the limitation of many sites in the large-scale plantings made up of cuttings planted in different years, we saw value in monitoring survivorship of cuttings in random plots within the large-scale plantings, simply to determine the likely outcomes of the South African government's investment in planting 21.5 million cuttings over the past 12 years.

In June and November 2015 we collected survivorship data in large-scale plantings from 47 plots in Addo Elephant National Park and 17 plots in Great Fish River Nature Reserve (Figures 1 and 2). We used the STRP database hosted by the Gamtoos Irrigation Board in Patensie (Eastern Cape) to identify appropriate areas for sampling across a range of topography and geology. At each plot (20 m by 20 m) we counted all living cuttings and estimated survivorship using the assumption that each plot had originally contained 100 cuttings. This assumption was based on the standard STRP planting protocol of planting cuttings 2 m apart, i.e. 2500 cuttings per hectare. It should be noted, however, that depending on the rockiness of a particular landscape, the distance between cuttings – and consequently the original number of cuttings in each of our study plots – would have varied.

The data show that survivorship in the large-scale plantings is extremely variable, ranging from 0 to 93%, with a mean of 28% across all 64 plots sampled (Table 1a). Geographical reasons for this variation were not evident in our data set (Table 1b,c; Figure 3). A generalised linear model showed, for example, that geology, aspect, elevation and slope were not related to survivorship.

To better inform planting protocols of future restoration efforts, we suggest that future studies examine the effects of inter alia soil temperature, soil water content and quality of planting operations on cutting survivorship. Importantly, the future monitoring of large-scale plantings should be undertaken in such a way that the effects of blanking can easily be taken into account in analyses of cutting survivorship. Lastly, permanent monitoring plots should be established in some of the large-scale plantings immediately after planting to ensure that accurate baseline data on the number of cuttings planted in a particular plot are captured.

A new planting protocol (Figure 4) that has proved successful in Camdeboo National Park is the planting of cuttings in bunches in trenches or micro-basins (Taplin B 2016, personal communication, May 5). This protocol ostensibly results in rainwater harvesting in the depressions which increases the rate of growth of cuttings relative to individual cuttings planted outside of depressions. If the dense clusters of spekboom cuttings ultimately form vigorous patches of mature plants that expand outwards in all directions – as is evident in some photographic records (Hoffman T 2016, personal communication, June 22) and old restoration sites[2] – the number of micro-basins excavated per hectare could be reduced to 25 to 50, as opposed to the current protocol of 2500 holes per hectare.

The average survivorship of 28% of the 21.3 million cuttings planted to date by the STRP means that the likely current legacy of the programme is ~6 million surviving spekboom cuttings. Based on results from old restoration sites[2,3], many of these cuttings will in time form large spekboom clumps which will – where herbivore stocking densities are appropriate – continue to expand for decades to come. The end result will consequently be a new matrix in which other species of thicket plants can establish.[4] Assuming that 5 million of the 6 million surviving plants will over the rest of the 21st century grow to establish thicket patches of ~4 m in diameter, based on a conservative 25-mm outward spread per annum (i.e. a 50-mm increase in diameter of the thicket patch per annum), ~7000 ha of thicket will have been restored by 2100 through an investment totalling ~ZAR100 million. Given the considerable benefits of restored compared with degraded thicket in terms of soil quality[3,5], infiltration of rainwater[6], carbon sequestration[7] and herbivore carrying capacity[8], this investment by the South African public is likely to be deemed worthwhile by future generations. To reach such a conclusion, however, a comprehensive analysis of the costs and benefits in terms of public goods (e.g. contribution to baseflow in rivers) and private goods (e.g. tourism and wildlife) over the ensuing decades would be required. Such an analysis would ideally track the change in value of the restored thicket through time and would assist government as well as the private sector to take informed decisions on investments in the upscaling of thicket restoration.

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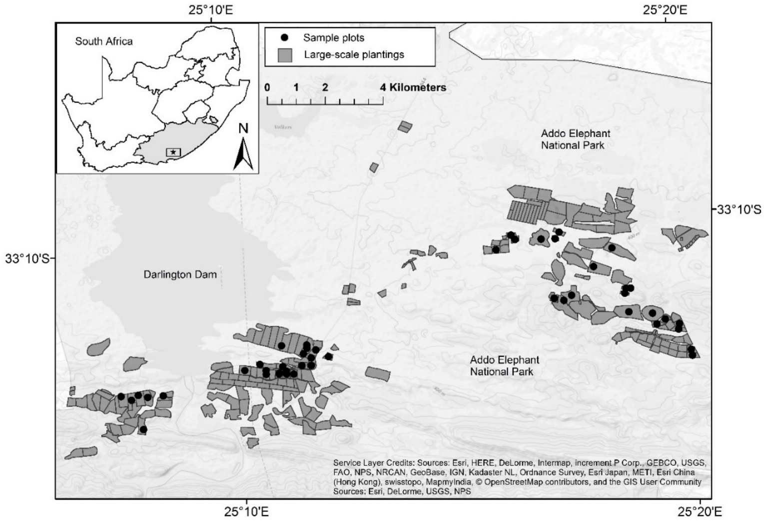

Figure 1: Sample plots and large-scale plantings in Addo Elephant National Park in the Eastern Cape, South Africa.

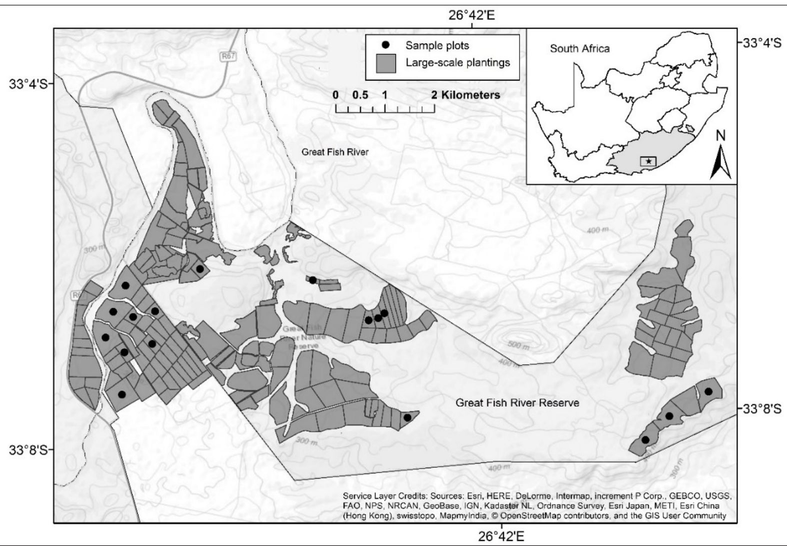

Figure 2: Sample plots and large-scale plantings in the Great Fish River Nature Reserve in the Eastern Cape, South Africa.

Table 1: Spekboom cutting survivorship (%) for different (a) sites, (b) geology types and (c) aspects

a

Site	*n*	Mean	Median	s.d.
Addo Elephant National Park	47	31	28	24
Great Fish River Nature Reserve	17	20	16	15
Combined	64	28	24	23

b

Site	Dwyka			Ecca		
	n	Mean	s.d.	*n*	Mean	s.d.
Addo Elephant National Park	29	35	28	18	25	14

c

Site	Flat			North-facing			West-facing		
	n	Mean	s.d.	*n*	Mean	s.d.	*n*	Mean	s.d.
Addo Elephant National Park	19	24	20	28	36	25	–	–	–
Great Fish River Nature Reserve	7	18	16	7	25	15	3	13	6
Combined	26	22	19	35	34	24	–	–	–

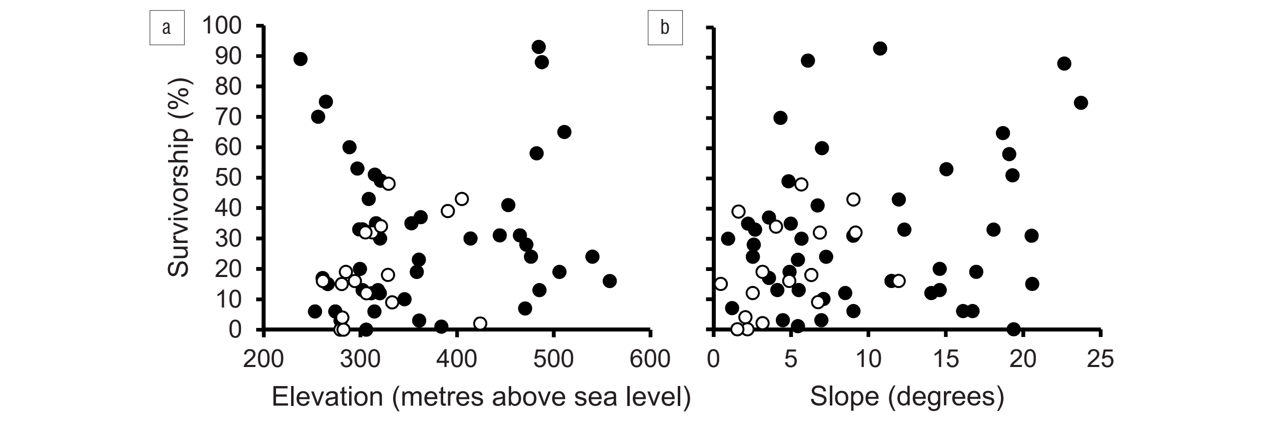

Figure 3: Spekboom cutting survivorship in relation to (a) elevation and (b) slope in Addo Elephant National Park (solid circles) and Great Fish River Nature Reserve (open circles).

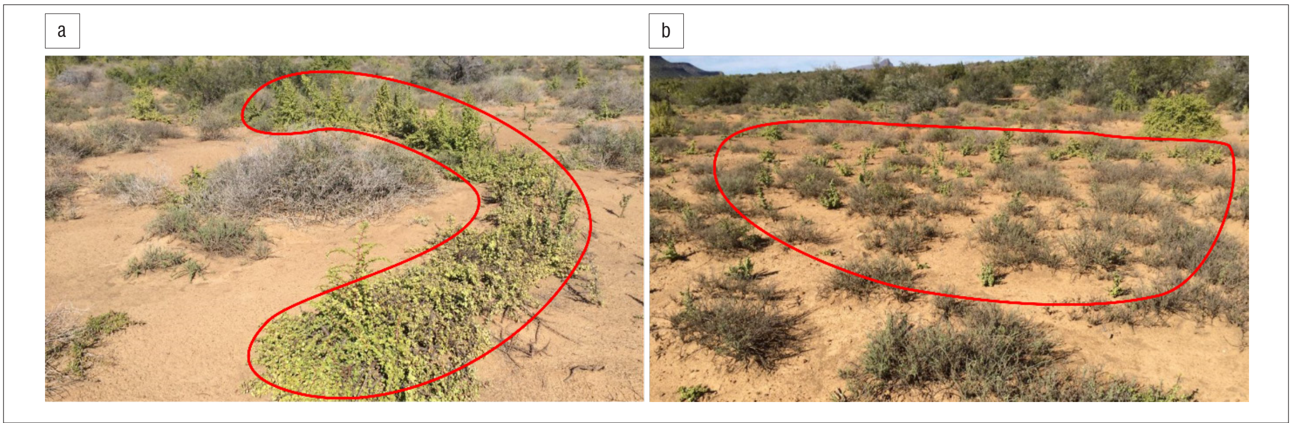

Figure 4: Comparison of spekboom growth after ~5 years after planting at Camdeboo National Park: (a) in dense clusters in a trench and (b) as single cuttings.

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