A philosophical approach to the distribution and spread of *Seriphium plumosum*

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Introduction

The encroachment of *Seriphium plumosum* (commonly known as slangbos, bankrupt bush or vaalbos) in productive grassland annually increases in severity. The name *Seriphium* is derived from seriph, a stroke or line of a letter; *plumosum* means feathery (Badenhorst 2009). The origin and causes of this encroacher plant will continue to be a controversial topic for a long time. This shrub, about 0.6 m high, might be better known to many as *Stoebe vulgaris*. A common view is that *S. plumosum* evolved from *Stoebe cinerea* by mutations which changed its character and enabled it to invade the grassveld (Roux 1969). This encroachment severely decreases the grazing capacity of grasslands and decreases of up to 75 to 80% have already been found in certain parts of South Africa (Richter 1989). Without knowledge of its actual origin, thousands of rands are spent annually on the chemical control of this plant.

Annually, every shrub produces thousands of seeds that are very light and easily carried by wind over long distances (Snyman 2009). There is speculation whether the common name slangbos is derived from the fact that the flower heads look like a snake rearing its head or from unsuspecting individuals finding a cobra curled up under it (Badenhorst 2009). The CARA-legislation (Regulation 16 of the Conservation of Agriculture Resources Act 43) listed *S. plumosum* as a proclaimed encroacher plant, requiring that where the natural vegetation is encroached upon, the land owner is obligated to control it (Jordaan and Jordaan 2007).

The species' light colour, which reflects sunlight, woolly covering and small leaves (Koekemoer 2001), which reduce water loss, are adaptations to survive long, dry summers. It is an aromatic plant, yielding volatile oil, which is also a protective measure as the plant is seldom eaten by livestock and then only when the plant is young (Badenhorst 2009). This is the prime reason why it has become such a problem in parts of this country where it proliferates in disturbed or overgrazed areas, explaining its common name, the bankrupt bush. Initially, most scientists assumed that it only invades in cases of overgrazing, but many examples show that when this plant first appears on a farm, the plant can even encroach on climax grassland (Snyman 2008). It prefers a sandy soil with low pH. For optimal growth, an annual summer rainfall of 620-750 mm is needed (Wepener 2007).

Figure 1 shows the present *S. plumosum* encroachment in grassland in South Africa. The Biomes in Figure 1 were taken from Rutherford and Westfall (1994). This is only a crude presentation to indicate its extent and may exclude certain grassland areas where *S. plumosum* does not yet dominate. The probability of further encroachment is indicated by arrows in Figure 1. Significantly, *S. plumosum* encroachment includes almost half of the Grassland biome. It remains to be seen whether we will eventually get to the bottom of and understand the reason for spread and manner of distribution of this plant so that scientifically based solutions can be found for its control. The following is a philosophical consideration of possible tendencies leading to its current distribution in South Africa. Though indigenous to South Africa, it has already spread to other countries in Africa (Figure 2).

Distribution from high mountains

In 1966, Prof. Brian Roberts, former departmental head of Grassland Science at the University of the Free State in the 1970s, conducted an ecological study on Thaba Nchu mountain, looking at vegetation/habitat relationships (Roberts 1966). *Seriphium plumosum* plants were found in 61 out of a total of 520 monitoring sites set out on the mountain. All the *S. plumosum* plants were found only on the southern slopes at higher altitudes. It is postulated that this is due to the higher rainfall and cooler temperatures higher up the mountain, and therefore moister. Mist also occurs regularly in the mornings higher up the mountain. The soil pH and fertility also decrease with altitude with more sour grasses dominate high up the mountain. Roberts' (1966) results show that *S. plumosum* is most closely associated with the unpalatable grass *Cymbopogon dieterlenii*. Fynbos vegetation increases enormously with altitude. Unfortunately, there is no record of the botanical composition of the vegetation at the foot of the mountain in 1966. Whether *S. plumosum* plants did occur at that time in the valleys surrounding the mountain, is an open question. Most of the older local farmers are of the opinion that no *S. plumosum* plants occurred around the mountain at that time. One can only theorize that the serious distribution below the mountain probably occurred over the past four decades.

It is probable that *S. plumosum* which occurred on Thaba Nchu mountain in 1966 (Roberts 1966),

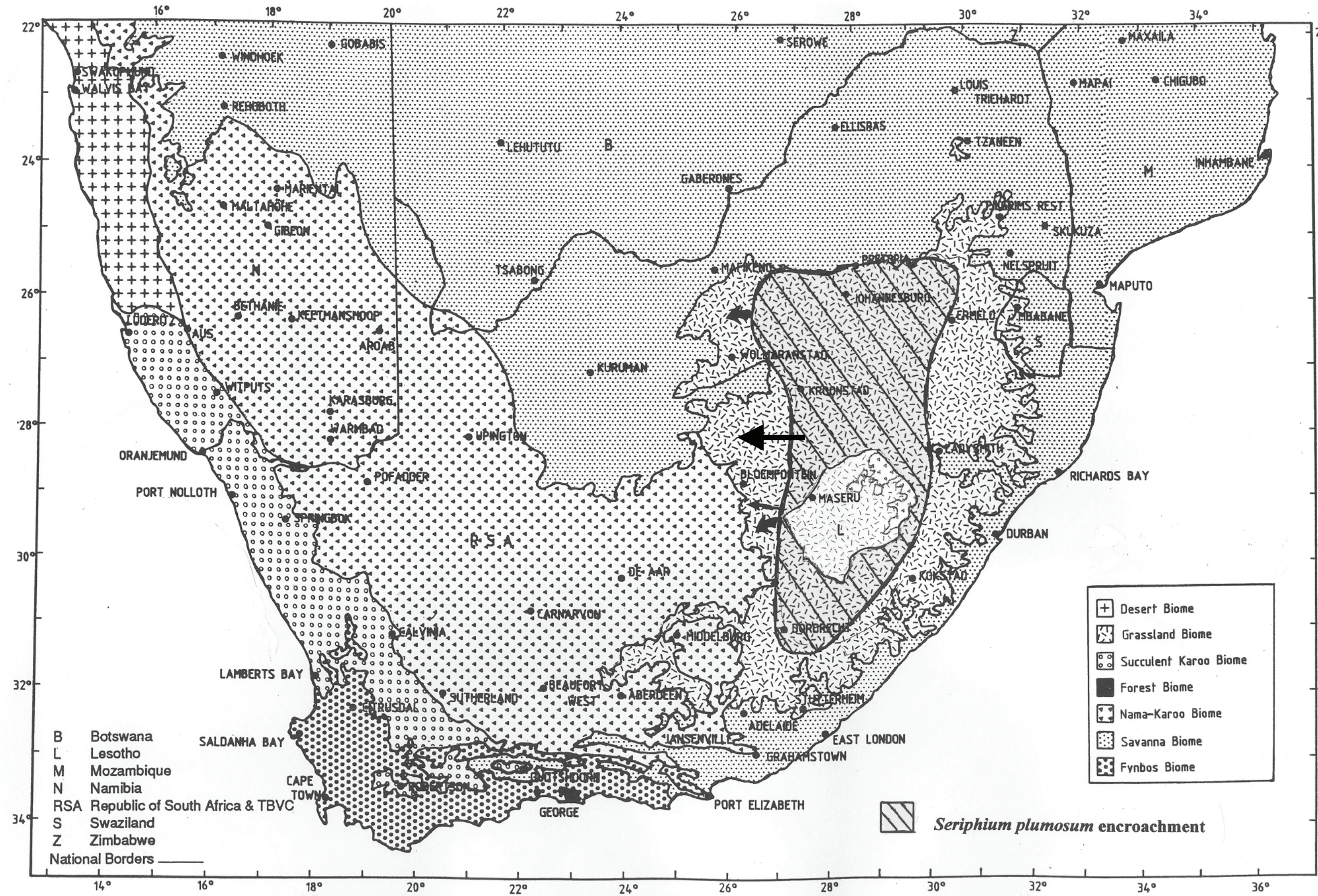

Figure 1: Biomes of South Africa and *Seriphium plumosum* encroachment in grassland areas. Map of biomes from Rutherford and Westfall (1994).

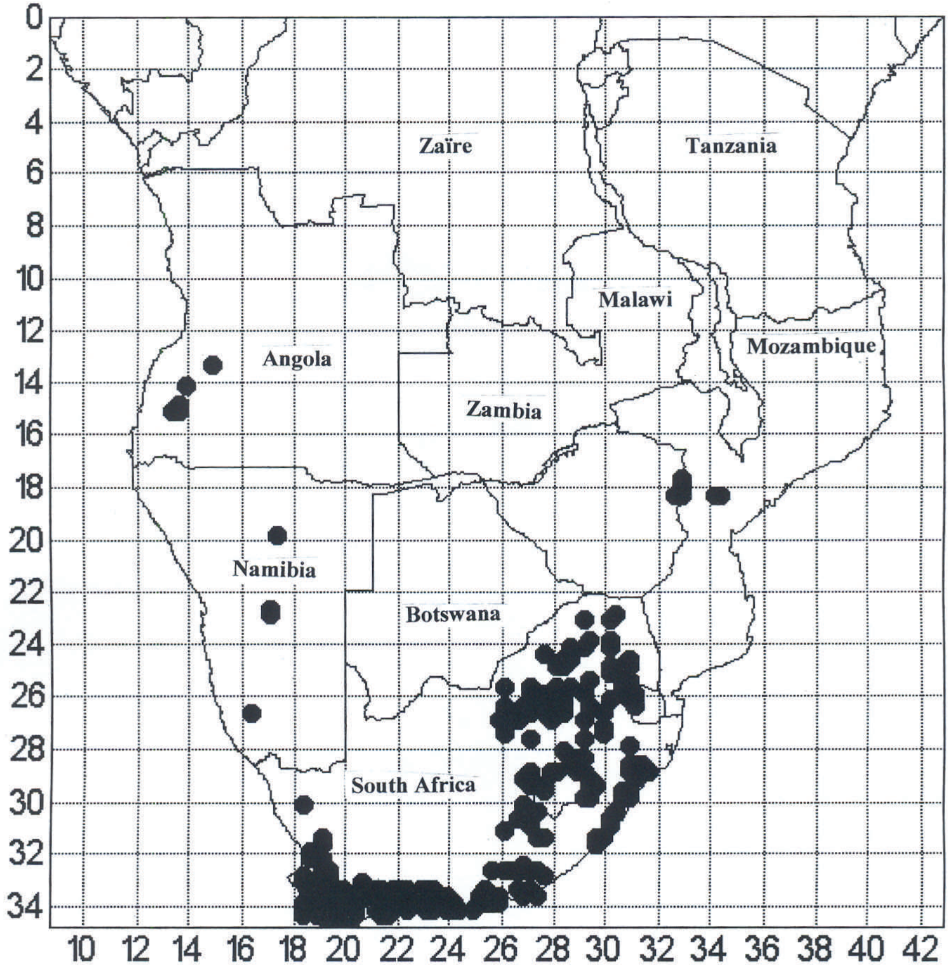

Figure 2: ***Seriphium plumosum*** **distribution over Africa (Koekemoer 2001).**

spread down the mountain by means of the very light seed over the years. It is further interesting that scientists divide the area of the mountain into two different land types, namely the part west of the mountain in the direction of the town of Thaba Nchu/ Bloemfontein and the eastern part towards Tweespruit/Ladybrand (LTSS 2008), Each land type is characterised by its own unique soil forms and climate (rainfall and temperature). The mountain range stretching north/south forms a rain shadow, so that less rainfall is received by the western land type which is dominated by sweeter grasses like *Themeda triandra* and soil with a higher pH than the eastern land type, where the grassland and soil are more acidic due to sandier texture and the higher rainfall.

Interestingly, no *S. plumosum* plants have been found in the western land type, in contrast to the severe encroachment in the eastern land type. This presence or absence can figuratively be cut with a knife as observed when the mountain range is crossed between the towns of Thaba Nchu and Tweespruit. This noticeable phenomenon is a clear illustration of the habitat preferences of this encroacher plant.

It can further be hypothesised that in areas where *S. plumosum* is presently found, it has always occurred on the higher mountains and only over years spread down the mountains to the lower-lying areas where it is found today. The seed was possibly spread by wind over long distances. So, the higher mountains in the *S. plumosum* encroached areas possibly carried an ancient fynbos component of which *S. plumosum* was one species. The genus *Seriphium* consists of 34 species with *Seriphium plumosum* known as the most aggressive grower and encroacher (Wild 1980). It first established on the southern cooler/more moist slopes and later spread to the valley with sandy/acidic soil and high rainfall. With the ridges first occupied, its distribution snowballs further onto the plains. It is seldom found in the wet (vlei) areas where the clay content and fertility of the soil may be too high (Snyman and Le Roux 2009). Cultivated areas withdrawn from cash crops are also favourable encroacher areas.

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Another good example is Aasvoëlberg near Zastron where *S. plumosum* also possibly only occurred on the high mountain as part of the fynbos component historically. Presently the foot of the mountain is infested with the densest *S. plumosum* stands found to date. In the 1970s, the only *S. plumosum* encroachment in the whole district was observed around the south/western side of Aasvoëlberg on a low potential cultivated area, the first one withdrawn from cash crop cultivation. Those days all cultivated areas were planted with maize or wheat and not with pastures. This *S. plumosum* distribution on the disturbed area perhaps occurred from the mountain tops (western slopes of Aasvoëlberg) over years and therefore the first large seed source for further distribution to other areas.

It is perhaps not farfetched to assume that *S. plumosum* over the past few years has spread from the tops and slopes of many other high mountains to lower-lying areas leading to the present widespread encroacher problem, as is the case with Thaba Nchu and Aasvoëlberg.

The very light *S. plumosum* seed which can be taken high up in the air with dust storms, also has the ability to spread over vast distances to areas where it previously did not occur. The period that these small seeds can survive in the soil without losing viability, is presently being investigated in depth.

Distribution through stock feed and animals

The possibility must not be excluded that the distribution of *S. plumosum* could also have taken place by means of animals and stock feed. The following is speculation on how the plants seed could have reached Thaba Nchu mountain years ago, as an example.

In 1836/37, the Voortrekkers Retief, Trichardt, Potgieter and Cilliers spent many months on the southern slopes of Thaba Nchu mountain. They came from the sourveld of the Amatole and Winterberg mountains of the Eastern Cape province where *S. plumosum* occurred abundantly. The question is whether the wheels of their wagons were clean of *S. plumosum* seed before their departure and whether seed could possibly have been transported in the wool and hair of their animals. They could also have brought forage for their draft animals, containing *S. plumosum* seed. Perhaps when Retief left for Natal with his 1 000 wagons from Thaba Nchu he took some Chrysocoma over the border? There are certainly other such examples where earlier missionaries and other travellers exploring the land could have spread the *S. plumosum* seed.

Future problems

In experimental sites at Bloemfontein (530 mm rainfall, sandy/loamy soil with a pH of 5.8) where no *S. plumosum* plants have ever been found, *S. plumosum* seedlings were planted which established very well and are presently growing actively. It is not unreasonable to predict that this problem plant will continually encroach outside its present favourable habitat over the years ahead. When more favourable habitats are encroached on, it may even spread to the lower rainfall areas, as the successful artificial establishment in the Bloemfontein area shown. For example, the more arid land type to the west of the Thaba Nchu mountain range, where no *S. plumosum* is presently found, could perhaps be invaded over a number of years if *S. plumosum* encroachment is not actively controlled. It is expected that cultivated areas and disturbed areas will be the first to be encroached on. There is thus cause for concern that the more arid grassveld areas may not escape *S. plumosum* encroachment in the medium term.

Earlier research

In the past, scientific advance has been impeded by the uncritical acceptance of easy generalizations. This is well illustrated in the case of *S. plumosum* (Roux 1969). As with all deleterious changes, the spread of this perennial in rangeland was attributed by ecologists of the old school to the twin evils of burning and overgrazing. From 1933 on-

Table 1: Mortality of *Seriphium plumosum* after different times of burning

Month of annual burn	Mean % mortality of *S. plumosum*
June	3.73
July	2.31
October	7.87
November	85.30
December	82.81
January	52.32
Control (no burnt)	2.58

wards, researchers from the University of the Witwatersrand under the direction of Prof. John Phillips devoted much attention to the problem of *S. plumosum* encroachment. Nearly all the conclusions they reached were subsequently questioned by later workers, who were able to benefit from long-term experiments actually laid out by Phillips (1930), Gillman (1934) and Van Rensburg (1941) from 1932 to 1933. The first published report on the subject was made by Cohen (1935). He described the general characters of the plant, its root system and the germination of its seeds. He reported no success in attempts to eliminate it by burning. He attributed its spread to overgrazing. Reporting in 1936 on some of the seed tests carried out, Cohen (1935) made the interesting statement that "the influence of direct sunlight depressed germination of *S. plumosum*". This observation, confirmed by Lecatas (1962) many years later, might have led to the conclusion that overgrazing, which reduces the grass cover and therefore increases light intensity at ground level, would discourage the germination of the seeds. Viewed from this angle, overgrazing could not be a cause of *S. plumosum* encroachment, and would be more likely to have the opposite effect. Van Rensburg (1941) reported briefly on methods of destroying the plant by poisoning and mattocking. No further reports on *S. plumosum* occurred for the next thirteen years, but the comprehensive experiments laid out in 1937 began to produce interesting results, which were reported by Hatting (1953) and by Smit (1955). Hatting (1953) found little evidence that overgrazing is a direct cause of *S. plumosum* encroachment. Regarding burning at different seasons, Hatting (1953) found that burns during the winter months have little effect, but burns in the spring and summer prevent the establishment of *S. plumosum* seedlings and therefore the encroachment of the plant. A subsequent report by Smit (1955), who set out new seasonal-burn experiments, confirmed Hatting's findings. A full report on the *S. plumosum* experiment was made by

Krupko and Davidson (1961). Annual burning in August showed appreciable increases in *S. plumosum,* but nothing like that in the unburnt plots. This was not the end of the *S. plumosum* experiments, however. By 1953 it had become evident that burning was a possible method of controlling the seed. The reduction in the degree of re-infestation resulting from August burns was considered to be due to the distribution of young seedlings by fire. The conclusion drawn was that the mature plants could resist an August burn but eventually succumbed to old age. The average life-span of individual plants appeared to be about fifteen years.

A further *S. plumosum* experiment was laid out by Davidson in 1953, looking at the effect of regular burning at different times. Replicated plots were burnt every year in one of the following months: June, July, October, November, December and January. Ordinary burning in the summer months, November to January, was sometimes difficult, but was achieved by means of a flame-thrower. The results obtained after six years are summarized in Table 1.

The *S. plumosum* problem, as studied at Frankenwald the University of the Witwatersrand's Botanical Research Station over a period of thirty years, illustrates the tremendous value of long-term experiments on rangeland (Roux 1969).

Discussion

The above theorizing is offered only as a means of increasing the level of awareness of the seriousness of the *S. plumosum* problem. I prefer the first approach where the distribution of *S. plumosum* is assumed to have occurred on high mountains to the theory of its distribution by stock feed or animals. There may be many other opinions on the serious spread of this plant, especially over the last 10 years. It is hoped that when all these thoughts are combined, a solution to this problem can be found, hopefully in the near future.

The control of this invader is not being seriously addressed at present. Contributing to this is the widely diverging opinions regarding its control and eradication. It is currently impossible to single out a "best" method of *S. plumosum* control as various factors influence its practical application in different districts, for example topography, accessibility and negotiability of the terrain. The effectiveness of *S. plumosum* control is also determined by factors like time of year, clay content of the soil and density or stand of the shrubs. The control measures chosen must be economically, financially and ecologically justifiable. The danger is that after cleaning a farm from *S. plumosum* encroachment, it can take over again from seeds coming from the neighbouring farms. The following are a few short comments on its control.

Unfortunately, no biological control measures are currently known.

There are many opinions on mechanical control (chopping action), which is labour intensive and does not show lasting success. If the plant is not cut underneath the soil surface, it definitely regrows. A follow-up or post-treatment is also necessary to control those seedlings emerging after the removal of the mother plant. As lots of seeds are further spread during the chopping-out process, the chopped shrubs must be removed and burnt or the problem can intensify.

No scientifically based fire control measures are known, except the work done in the 1950s. The wrong time of burning can also increase the problem.

Seriphium plumosum can be very successfully controlled chemically (granular formation or suspension) with agents even having a residual effect of a few years to control those seedlings which may emerge later on. This is naturally an expensive process to be addressed correctly.

It is very important to concentrate initially on those areas with sparse or moderate encroachment, to prevent further spreading, then to treat the denser stands later.

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