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The control of silky hakea in South Africa

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ABSTRACT

The introduction of *Hakea sericea* Schrad. from Australia to South Africa and the weed problems it presents today are described. The three methods of control currently used to combat this menace (mechanical, biological and chemical) are described and the integration of mechanical and biological control is advocated.

RÉSUMÉ

LA LUTTE CONTRE L'HAKEA SOYEUX EN AFRIQUE DU SUD

L'introduction de l'Hakea sericea *Schrad. d'Australie en Afrique du Sud et le problème de nuisance qu'il présente aujourd'hui, sont décrits. Les trois méthodes de lutte couramment utilisées pour combattre cette menace (mécanique, biologique et chimique) sont décrites et l'intégration des moyens de lutte mécanique et biologique est préconisée.*

INTRODUCTION

The genus *Hakea* belongs to the subfamily Grevilleoideae in the family Proteaceae. The Proteaceae are well represented in both Australia and South Africa, although the genus *Hakea* does not occur naturally in South Africa. *Hakea sericea* Schrad., commonly known as silky hakea (Stirton, 1978), is thought to have been introduced to South Africa in 1833 by the Baron C.T.H. von Ludwig (Annecke & Neser, 1977). The species *H. sericea* has many forms in Australia (Neser, 1968) and the form introduced into South Africa is thought to have originated from the Sydney area (Annecke & Neser 1977). The environment in the Sydney area is sufficiently similar to the south-western Cape to enable *H. sericea*, a plant introduced without its controlling agents (Neser, 1968), to grow vigorously. It seems that all *Hakea* species that have become pests (Fugler, 1979), were popular as hedging plants, although they also had other uses (Stirton, 1978). Phillips (1938) records that *H. sericea* became such a problem in the Knysna area that the local Farmers Association requested that the plant be proclaimed a noxious weed. This was done in terms of proclamations 161/1938 and 171/1940 of the Weeds Act, No. 42 of 1937. A literature review on *H. sericea* has been made by Fugler (1979).

PROBLEMS ASSOCIATED WITH SILKY HAKEA

Conservation problems

Silky hakea has colonized much of the mountainous area of the south-western and southern Cape. The natural vegetation of these areas is fynbos, a unique and threatened vegetation type (Taylor, 1978). The general distribution of *H. sericea* is shown in Fig. 1. The extent of infestation is not reliably known, but available figures are given in Table 1 (Fenn, 1980, Directorate of Forestry records, unpublished). *H. sericea* is able to establish abundant populations in a few generations. Such populations almost eliminate the natural communities under them. Although no accurate information as to the precise nature of these effects is available, such invasion is certainly detrimental to the natural fynbos vegetation. Kruger (1977a) states 'it is clear that weed populations in the natural veld are totally incompatible with the conservation of the Cape fynbos'.

Effect on catchment water supplies

The effects of afforestation on catchment streamflow are well documented in South Africa (Banks & Kromhout, 1963; Wicht, 1967 and Malherbe, 1968). The information shows that conversion from low plant communities such as grass- or shrublands to forest almost invariably results in a decline in streamflow (Kruger, 1977a). Since *H. sericea* is a small tree, dense infestations could be expected to decrease streamflow. A hydrological project conducted by the Directorate of Forestry is seeking to answer this question.

Effect on fire hazard

The fynbos vegetation of the Cape is susceptible to fires which may be difficult to contain (Kruger, 1977a). Experience has shown that *H. sericea* changes the nature of the fire control problem. Since *H. sericea* stands contain a greater proportion of coarse flammable fuels than the native fynbos species, the potential for blow-up fires, especially under severe weather conditions, is increased where *H. sericea* is dominant (Kruger, 1977b).

CONTROL MEASURES

Mechanical control

Early attempts at the manual control of *H. sericea* were not always successful. Common mistakes included cutting the plant above the lowest green leaves, thus enabling the plant to survive; failing to burn the area before seedlings produced fruit; lack of follow-up to remove surviving plants after burning; and a lack of co-ordination between parties involved in clearance operations. In 1976 the Department of Forestry (now the Directorate of

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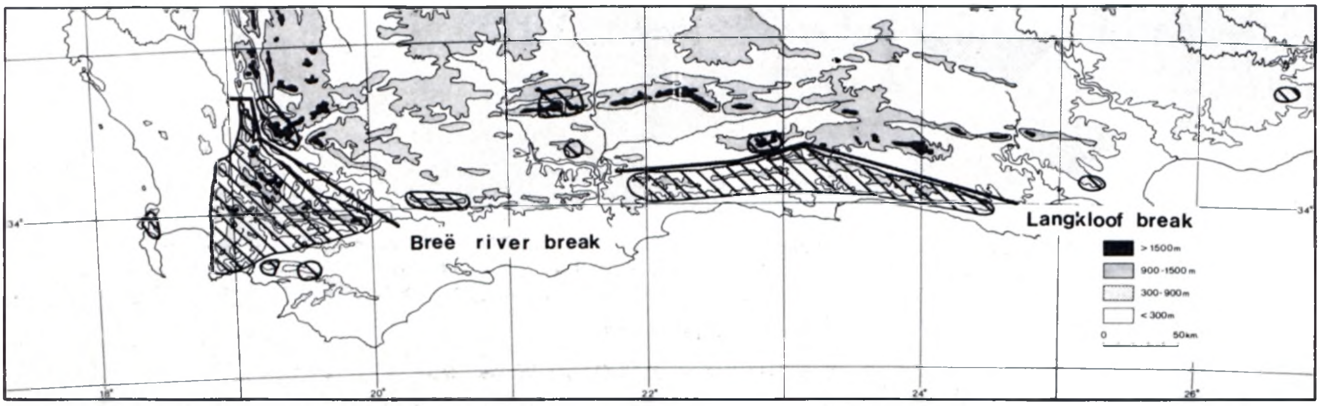

FIG. 1.—The distribution of *Hakea sericea* in the Cape Province, South Africa.

TABLE 1.— Known extent of *Hakea sericea* infestation in the Cape Province

Degree of Infestation	Area infested (ha)		
	Western Cape Forestry Region	Southern Cape Forestry Region	Tsitsikamma Forestry Region
Dense	8 600	15 220	7 609
Medium	184 000	16 270	15 559
Sparse	192 000	38 930	11 851

* Dense = Stems less than 4 m apart

Medium = Stems more than 4 m apart, but individual plants always visible

Sparse = Individual plants present but not always visible.

Forestry in the Department of Environment Affairs) started a mechanical eradication programme (Fenn, 1980).

The mountainous fynbos areas under the control of the Directorate are divided into management units termed compartments. These range from 100 ha to 1 000 ha in size, depending upon the terrain and degree of infestation by alien vegetation. They are burnt on a 12-year cycle which enables the fire-adapted fynbos vegetation to regenerate (Van Wilgen, 1980). All *H. sericea* plants present in the compartment are cut down before burning. The distances that labour operates from Forest Stations sometimes necessitates the building of temporary huts in the mountains from which the crews operate for five-day stints. The felling of *H. sericea* is carried out using a combination of slashers, beanhooks, bowsaws, mechanical bush cutters and chainsaws (Le Roux, 1978).

The cut plants are left to lie for 12 to 18 months. During this period the fruit on dead plants opens and releases the winged seed. This has little chance of being blown any distance as the parent plant is no longer standing upright. Seeds germinate around the fallen parent plants, but before they produce fruit the compartment is burnt, destroying the seedlings. Every two years after the fire the area is searched and every surviving *H. sericea* seedling found is pulled out. This task is called 'follow-up' and is considered to be the most arduous part of the control task (Le Roux, 1978).

Mechanical control is the most effective eradication method known at present. During the period 1976 to 1979 *H. sericea* was cleared from 13 376 ha in the western Cape Forestry Region (Fenn, 1980) and 17 267 ha had been cleared from the Southern Cape Forestry Region by the end of 1980 (H. Wilhelmij pers. comm., 1980). *H. sericea* infestations occurring on private land are a serious problem and the legal situation is at present under review. The Directorate hopes to clear the mountains of *H. sericea* in the next ten years but as the programme advances the amount of follow-up work will snowball.

Biological control

Biological control was initiated in 1962, when Webb was sent to Australia to investigate possible controlling agents (Annecke & Neser, 1977). Neser (1968) continued the work and noted that in areas of Australia where seed attacking insects were absent, *H. sericea* produced large numbers of fruit as did the plants in South Africa.

The destruction of large numbers of seeds in perennial plants is normally considered of little value for biological control. Neser reasoned that this did not apply to *H. sericea*, as its reproductive strategy is similar to that of annual or biennial weeds, because the fruits are retained on the plant and released in large numbers after its death. The only real difference between *H. sericea* and annual or biennial weeds is the time period between generations. The destruction of large amounts of *H. sericea* seed is therefore regarded as a useful control method (Neser, 1968).

No indigenous South African Proteaceae have similar fruits to *H. sericea* and seed-attacking insects show a high degree of specialization (Neser, 1968). For this reason, it was thought safer to release seed-attacking insects than insects that attack vegetative parts of the plant. Seed-attacking insects that have been released are the hakea fruit weevil, *Erytenna consputa* Pascoe (Annecke & Neser, 1977) and the hakea seed moth, *Carposina autologa* Meyrick (S. Neser pers. comm., 1977).

E. consputa is now well established at some 99 release sites in nearly all the infested mountain ranges between Cape Town and Grahamstown. More releases are planned with the emphasis on the southern Cape. At one of the release sites where the weevil damage is being measured, 58% of the 1980 fruit crop was destroyed by *E. consputa*. It is confidently expected that this will still increase substantially (R. Kluge pers. comm., 1981).

Progress with *C. autologa* has been slow since large numbers are required for establishment. Research on better breeding methods is continuing (S. Neser and R. Kluge pers. comm., 1980). Once established, however, *C. autologa* should complement *E. consputa* very well, by further reducing the seed store in the developed follicles on the trees.

More recently a less conservative, but still very safe, approach has been taken and some attention has been given to insects attacking the vegetative parts of plants. It is hoped that these insects will supplement the seed-attacking insects (R. Kluge pers. comm., 1980). A leaf-boring weevil, *Cydmaea binotata* Lea, was found to be specific to *H. sericea* and released in 1979. It is hoped that this insect will reduce the growth and competiveness of seedlings. Research on a weevil *(Dicomada rufa* Blackburn) that destroys flower buds has started and further work on a variety of insects is planned for 1981 and 1982 (S. Neser and R. Kluge pers. comm., 1980).

An endemic fungus identified as a *Collectotrichum* state of *Glomerella cingulata* (Stotem.) Spauld. and Schenk also attacks *H. sericea*. The disease occurs widely and is common in many *H. sericea* stands. Areas of *H. sericea* with more than 90% natural infection and many dead plants have been observed in both the southern and south-western Cape. The long-term effects of the disease on such populations have yet to be determined. The fungus is easily grown in culture and methods of encouraging the spread of the disease are also being investigated. Inoculation of *H. sericea* with the fungus has resulted in the development of symptoms of the disease, which causes cankers to develop on the stems and branches and may eventually girdle and kill them. Shoot tips may also become infected and die (M. J. Morris pers. comm., 1980).

Chemical Control

The development of herbicides is a costly and time-consuming process. Stricter regulations on the properties of herbicides has resulted in increasing the financial risk of herbicide development. Fewer companies are now committed to this form of research and they are producing fewer marketable herbicides per annum (Naylor, 1979). Thus the herbicides produced tend to have a broad spectrum effect, and there is little chance of a specialized *H. sericea* herbicide being produced.

Roundup (glyphosate) and Garlon (triclopyr) have been applied to *H. sericea*. The results from the glyphosate trials were disappointing. In a mature stand, not all individuals were killed and the stands could not be burned as originally planned. Garlon was found to achieve satisfactory control on plants 1–2 m tall. These herbicides are broad spectrum and expensive and therefore unsuitable (D.G.M. Donald pers. comm., 1980). Streamflow from the mountains is used for agriculture and as drinking water; introducing chemicals into the mountains would therefore be a dubious practice and should be avoided whenever possible.

CONCLUSIONS

It seems unlikely that any significant contribution to the control of *H. sericea* will be forthcoming from herbicides, largely because of their lack of specificity and cost.

Mechanical control as applied by the Directorate of Forestry has made great strides since 1976, and is at present the most effective way of removing the existing stands. Being a mechanized, labour intensive method, its feasibility is subject to increase in the cost of labour, equipment and fuel.

The biological control programme is starting to produce noteworthy results and indications are that *Erytenna consputa* will be causing a significant reduction in seed production in the near future. This will, it is hoped, have short-term benefits by reducing the need for follow-up work. In the longer term, however, together with *Carposina autologa,* it is forseen that *E. consputa* will prevent the build-up of seeds on isolated plants, or on plants in inaccessible places. This will reduce the aggressiveness of the weed.

Because of a lack of proper evaluation the contribution of the disease caused by *Collectotrichum* has been underestimated. Now that it is the subject of a research project, its significance is likely to be recognized and it will be possible to make more effective use of it in the control effort. It can be used in combination with mechanical control, where it has proved extremely effective in killing cut stumps that still have fruit on them. The pathogen could be applied by brushcutter blades or by hand brushes, thus ensuring that these fruits also release their seed before the area is burnt.

In order to ensure the build-up and survival of a viable population of controlling insects, small areas of *H. sericea* should be left untreated. As long as these 'reserves' are not burnt, seeds will remain on the adult plants, thus preventing their spread. A combination of mechanical control and subsequent follow-up by both human and insect agents shows good promise of bringing *H. sericea* under control.

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