WONGAN HILLS TRIGGERPLANT RECOVERY PLAN

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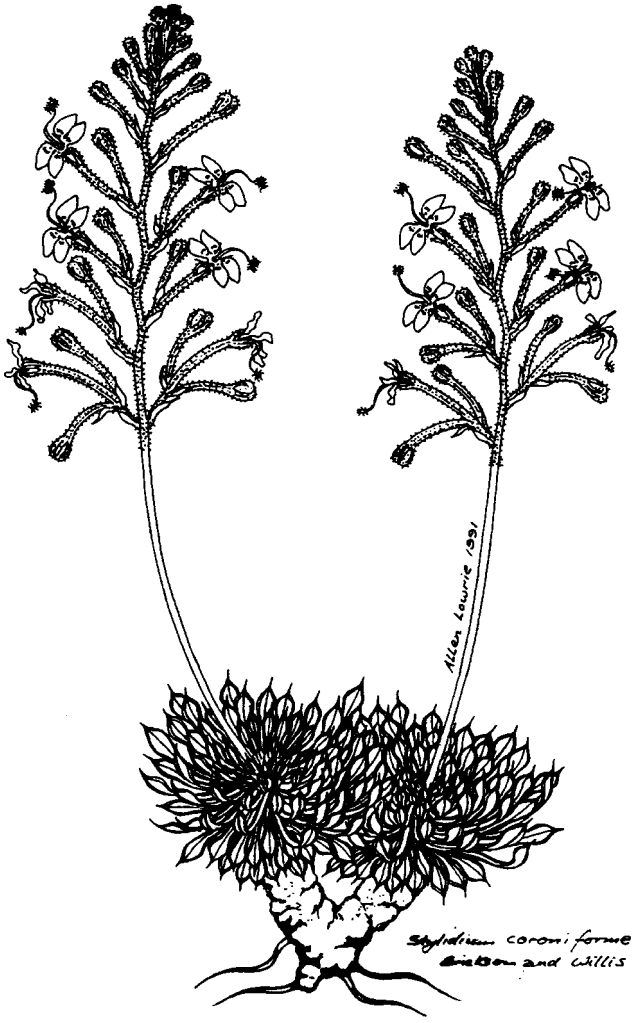
for the Wongan Hills Triggerplant Recovery Team



1995

Wildlife Management Program No 15

Australian Nature Conservation Agency

Department of Conservation and Land Management

WESTERN AUSTRALIAN WILDLIFE MANAGEMENT PROGRAM No. 15

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by Allen Lowrie

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1994

FOREWORD

The Western Australian Department of Conservation and Land Management (CALM) publishes Wildlife Management Programs to provide detailed information and management actions for the protection of certain exploited or threatened species of flora and fauna

Recovery Plans delineate, justify and schedule management actions necessary to support the recovery of an endangered or vulnerable species or ecological community. The attainment of objectives and the provision of funds is subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery Plans do not necessarily represent the views nor the official positions of any individuals or agencies represented on the Recovery Team. This Recovery Plan has been approved by the Executive Director, Department of Conservation and Land Management, the National Parks and Nature Conservation Authority and the Minister for the Environment.

Approved Recovery Plans are subject to modification as directed by new findings, changes in species' status and completion of recovery actions.

Information in the Plan is accurate at December 1992, although where it seemed important modifications have been made to provide updated information up to the end of 1993.

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SUMMARY

CURRENT SPECIES STATUS: Gazetted as Declared Rare Flora under Section 23F of the Western Australian Wildlife Conservation Act. There are five known populations of *S. coroniforme*, three in the Wongan Hills area and two some 140 km further north. They contain a total of about 400 plants. The species is vulnerable because there are no populations on conservation reserves, all the known sites have been affected by sheep grazing, gravel extraction, track clearance, road grading or a combination of these and other disturbances.

HABITAT REQUIREMENTS AND LIMITING FACTORS: A small perennial herb of moderately disturbed scrub-heath on sand over laterite. The enigmatic ecology of *S. coroniforme* (probably a disturbance opportunist) suggests large areas of habitat are necessary for its long term survival in the wild. Plant longevity is less than ten years. It is not known whether seed lives longer than one year in the soil.

ACTIONS NEEDED:

1. Establish a recovery team
2. Vest land as a nature reserve (two populations)
3. Rehabilitate the gravel pit site
4. Search for additional populations
5. Monitor and manage existing populations
6. Establish at least two new populations on the nature reserve
7. Germplasm collection
8. Seed research
9. Monitoring and reporting
10. Public display

Total Estimated Costs of Recovery (1991 prices in $000s/year)

Action	1	2	3		4		5		6		7		8		9		10		Total			
	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP	TC	ESP
1992	3	-	3	1.5	2.5	2.5	3	2.5	0.5	-	-	-	2	1	-	-	3.5	3	2	1.5	19.5	12
1993	3	-	3	1.5	19	16	3	2.5	0.5	-	1.5	1	1.5	1	13	10	3.5	3	2	1.5	50	36.5
1994	3	-	-	-	1	0.5	-	-	0.5	-	1.5	1	-	-	-	-	3.5	3	1	0.5	10.5	5
1995	3	-	-	-	1	0.5	-	-	0.5	-	1.5	1	-	-	-	-	3.5	3	1	0.5	10.5	5
1996	3	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	3.5	3	2.5	2	9.5	5
1997	2	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	2.5	2	-	-	5	2
1998	2	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	2.5	2	-	-	5	2
1999	2	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	2.5	2	-	-	5	2
2000	2	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	2.5	2	-	-	5	2
2001	2	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	2.5	2	-	-	5	2
Total	25	-	6	3	23.5	19.5	6	5	5	-	4.5	3	3.5	2	13	10	30	25	8.5	6	125	73.5

TC - Total Cost
ESP - Endangered Species Program funds required (= TC - CALM contribution)

BIODIVERSITY BENEFITS: Thirteen other threatened endemic plants occur in the Wongan Hills area. Creating the proposed nature reserve will provide protection for *S. coroniforme,* eight other species of Declared Rare Flora and three priority taxa which are endemic to this area and considered at risk.

1. INTRODUCTION

In 1980 *Stylidium coroniforme*, the Wongan Hills Triggerplant, was Gazetted under the Western Australian Wildlife Conservation Act as Declared Rare Flora. At that time only one plant could be found, the last of a once-flourishing population at the type locality. This recovery plan summarises the existing information about *S. coroniforme* and identifies actions that will ensure the species persists in the wild.

1.1 Taxonomy and description

The trigger plant genus *Stylidium* is the largest in the family Stylidiaceae (Erickson 1958). All species are annual or relatively short lived perennial herbs. Leaves may be scattered or arranged in basal rosettes, or in whorl-like tufts. Although many species are adapted to withstand dry conditions, most occur in acidic, mineral-poor soils of winter-wet sand heaths.

There are approximately 180 named species. Many of them have been described recently (Carlquist 1976, Lowrie and Carlquist 1991) and there are several newly recognised but undescribed taxa (Allen Lowrie pers. comm.). About 75% of the species occur in Western Australian. James (1979), reporting chromosome numbers in 119 species, found that several independent dysploid chromosome number reduction series had evolved in this State but not elsewhere. Burbidge and James (1991) consider that those perennial species with the haploid chromosome number of n=15, and a preference for mesic habitats represent the "primitive" condition in *Stylidium*.

Stylidium has proliferated in the south-west of Western Australia. Amongst several factors that may have promoted speciation are: fidelity to particular soil types within an intricate mosaic (Carlquist 1969; Lowrie pers. comm.), climatic fluctuations during the Quaternary (Hopper 1980), peculiarities of the floral structure and breeding system (Carlquist 1969; Burbidge and James 1991) and chromosomal repatterning (Coates and James 1979; Coates 1981, 1982). Although hybridization is considered to be rare in *Stylidium* (Carlquist 1969; Banyard and James 1979; Farrell and James 1979; Lowrie pers. comm.) localised hybridisation has been recently documented among species of the *Stylidium caricifolium* species complex (Coates and James, in press).

Mildbraed (1908) used capsule forms to divide *Stylidium* into several subgenera and sections which Carlquist (1969) considers to be fairly natural. This arrangement derives some support from cytological studies (James 1979). Erickson (1958) and Grieve and Blackall (1982) use various growth forms in their keys to the species. *S. coroniforme* belongs in the subgenus *Nitrangium* (linear capsules) section *Sonderella*. Chromosome numbers of both disjunct population systems of *S. coroniforme* are n=12 with the numbers in other species of *Nitrangium* being n=11, 13, 14, 15 and n=26, 28, 30 (30 species; James 1979).

A detailed description of *S. coroniforme* can be found in Erickson and Willis (1966). The species is distinctive for its very long ovary (sterile in one loculus), its racemose scape and conspicuously marginate leaves. The epithet "coroniforme" refers to the attractive, crown-like arrangement of the inflorescences which encircle the rosettes.

1.2 Habitat and distribution

In Western Australia several species of *Stylidium* are rare and considered threatened. In many cases disturbance or destruction of habitat associated with agricultural settlement has contributed (at least partly) to their status (Leigh *et al*. 1984). *S. coroniforme* exemplifies this situation. The species was described by Erickson and Willis (1966) from one locally abundant population found in 1963 in the Wongan Hills, about 150km north-east of Perth. The owner of the property, Mrs M. Rogers, later found a second roadside population which has subsequently vanished. In 1980 only one surviving

plant could be found at the type locality (Rye 1980) and the species was promptly gazetted as Declared Rare Flora.

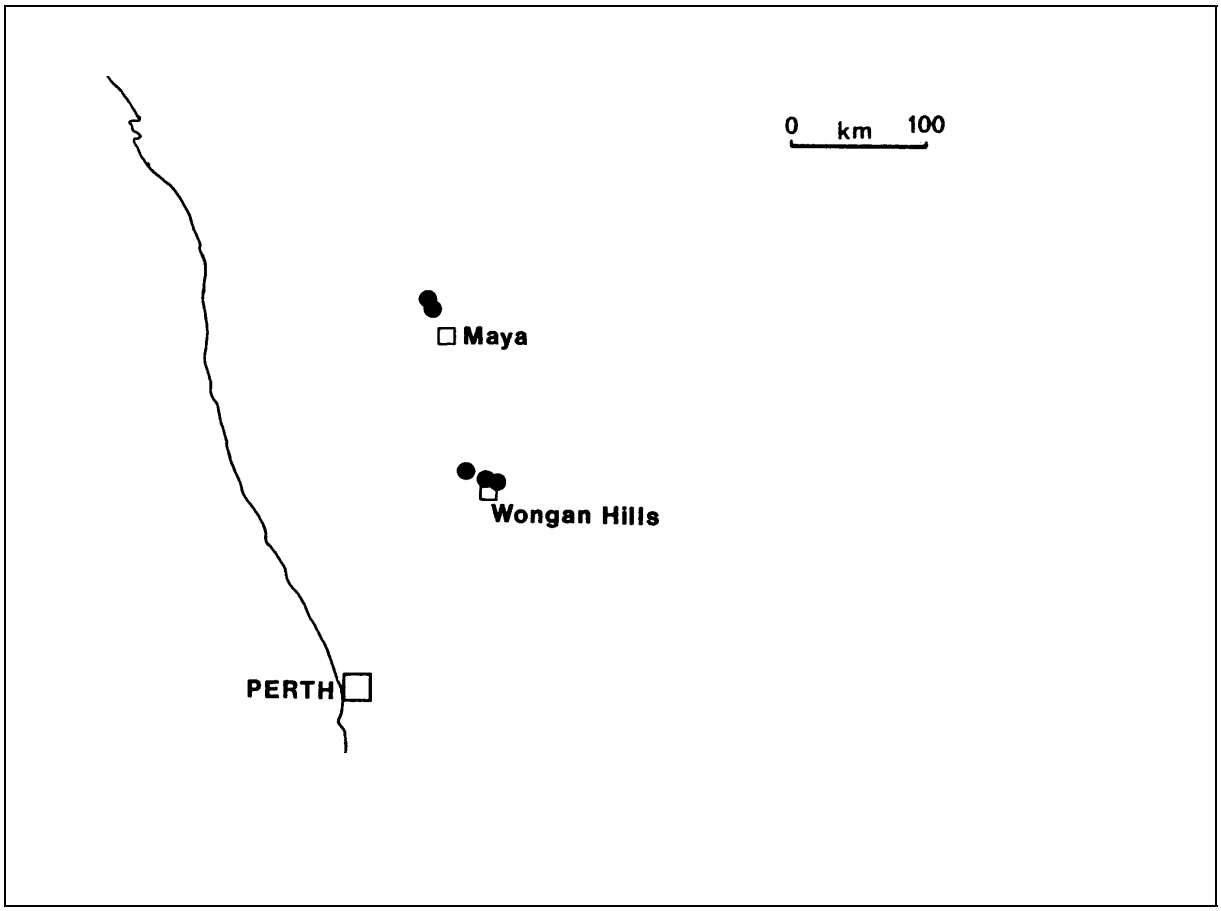


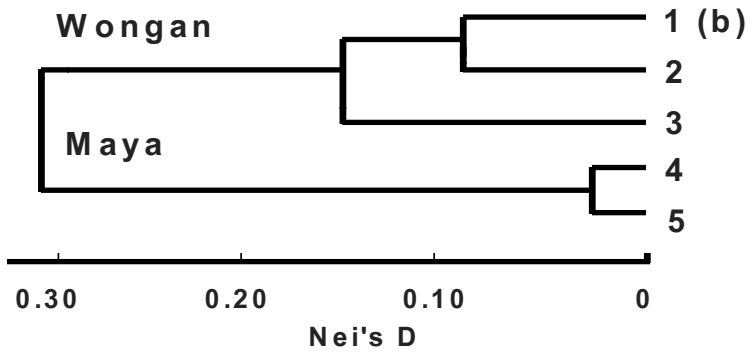
Figure 1. Distribution of *Stylidium coroniforme*

Soon afterwards CALM built a stockproof fence enclosing 2.5ha around the site. In spring 1981 a second plant was discovered. It had several rosettes and was flowering. CALM officer Phil Roberts spent several days in the field cross-pollinating the two plants by hand. Nearly 100 seeds were obtained and distributed to Murdoch University and Kings Park and Botanic Garden. From them the species has been tissue cultured and propagated (McComb 1985). Kings Park and Botanic Garden maintain several glasshouse plants.

In spring 1982 a third plant was found. Apparently it was a juvenile as it was not flowering. Two years later (1984), there were 25 plants, mostly seedlings, inside the fenced area (J. Briggs, unpub. data). In 1985 seven more plants were found. As they were outside the enclosure the fence was extended to include them (P. Roberts, internal CALM report). The population had increased to 86 plants by 1986 but by 1989 it had declined to about 50 plants. Drought and increased exposure are likely to have been significant factors in the population decline over this period. In 1991 there were only 29 plants growing in crevices and small hollows on sheet laterite (Coates, 1992). The site originally had a shallow layer of sandy soil but that has disappeared.

Four more populations have now been located (Fig. 1). One was found in 1982 6km east of the type locality. When it was discovered it contained "about 1000" plants. It is situated under powerlines on a Water Reserve. In 1991 only about 150 plants were located. The area had been burnt around 1979, and the powerline route was cleared in 1980. The population extended about 50m between two power poles and the very localized distribution suggests that the original population was small. The flush of

numbers noted in 1982 was evidently a response to one or both disturbances. It is likely that the original plant(s) had survived the fire as either seed or rootstock.



(b) population exposed to presumed genetic bottleneck

Figure 2. UPGMA dendrogram based on Nei's genetic distance showing genetic relationships between the five populations of *Stylidium coroniforme*

In 1991 a third population was found about 2km east of the second. The plants are growing on disused tracks around the edge of a large laterite gravel quarry. About 50 plants occur in the open on disturbed gravel, and another 100 or so are found in partial shade adjacent to *Allocasuarina* and *Dryandra* scrub, along 200m of track. In both situations the plants are confined to disturbed areas but the species has not colonised all of the disturbed sites.

Two more populations were discovered in spring 1989 (Lowrie, pers comm.) near Maya, about 140 km north of Wongan Hills. The two populations are only 1.4 km apart. They are growing between the Wubin-Mullewa Main Road (M39) and a railway line, and west of the railway line. Both sites carry remnant scrub on sandy lateritic gravel.

When they were discovered there were 25 mature plants in one population and 69 in the other. However in autumn 1990 a grader driver inadvertently destroyed plants in both populations, reducing numbers to about 17 and 25 respectively. Relevant authorities have now been told of the presence of threatened plants and markers have been installed at both sites.

S. coroniforme inhabits an area which experiences hot, dry summers and cool, wet winters. It favours sites with laterite (sheet or gravel) that may be overlaid with shallow sand, which tend to be fairly high in the landscape (Bettenay 1984). At Wongan Hills it occurs at 300-320m (Kenneally 1982). The number of rosettes in larger individuals suggests that plants may live for perhaps ten years. It has proved impossible to transplant, probably indicating that it has very deep roots. Lowrie (pers. comm.) suggests that the leaves may hold some water reserves.

The association with disturbed sites suggests the species is a disturbance opportunist but little is known about its reaction to different forms of disturbance. *S. coroniforme* seed has been germinated from collections at least two years old but longer term seed longevity both *in situ* and *ex situ* has yet to be assessed. However they can tolerate very hot soil surface temperatures over at least one summer, and presumably, they can tolerate the passage of at least some fires. It is possible that *S. coroniforme* seed persists in the soil for some years, germinating after the soil has been disturbed. The minute seeds germinate readily on a moist medium in autumn.

1.3 Pollination biology

Stylidium is well known for having a sensitive column (or trigger) which carries both anthers and the stigma. An insect alighting on a flower triggers the long elastic column which immediately descends with a hammer-like action from its folded or reflexed position. The action either sheds pollen on the insect visitor or, if the stigma is receptive, picks up pollen that the vector may have been carrying. The column is capable of resetting and being reactivated. Although insects promote cross-pollination they also give rise to significant levels of self pollination by visiting different flowers on the same plant.

A range of native bees, and bombyllid and syrphid flies have been reported to be pollen vectors for *Stylidium* (Erickson 1958, Banyard and James 1979). They are attracted by colourful petals. Nectar guides (deep coloured dots) are present and there is a copious nectar flow at the throat of the flower. It appears that sympatric species of *Stylidium* with overlapping flowering times deposit pollen on different parts of their insect visitors. This enables them to share pollinators (Carlquist 1969). Little is known about the pollination of *S. coroniforme* but a bombyllid fly visited flowers at Wongan Hills, and a trigonid bee visited flowers at Maya (pers. obs.).

S. coroniforme flowers from early-mid September until November, and sometimes into January if moisture availability permits. New flowers are yellow, but they change to white after 2 days. The colour change coincides with splitting of the bright red anthers to release pollen. The flowers remain male for up to 5 days, after which the stigma emerges between the anthers. Pollinated flowers wither within 2 days but unpollinated flowers can remain open for 14 days before withering. It takes 6 or 7 weeks for capsules to mature (P. Roberts, CALM internal report). This pattern appears to be typical of *Stylidium* (Banyard and James 1979).

Complete or near complete self-incompatibility has been demonstrated in 37 perennial species of *Stylidium* (Burbidge and James 1991). The mechanism appears to involve post-zygotic seed aborting recessive lethal genes, rather than stigmatic recognition of self pollen, so that most products of selfing abort early in seed development. Comparisons between self and cross pollinations indicate that seed aborting lethals are also present in *S. coroniforme*.

1.4 Population genetics and ecology

Allozyme studies show that, like other perennial triggerplants that have been investigated, *S. coroniforme* populations are characterised by relatively high levels of genetic diversity (Coates, 1992). There appears to be no relationship between population size and either the level of allelic diversity or heterozygosity. However, observed heterozygosity (*H*o) is substantially less than expected heterozygosity (*H*e) in all populations. The fixation index ranges from F=0.14 to F=0.31, indicating significant levels of inbreeding. This suggests that this species tolerates relatively high levels of inbreeding in its populations even though it has a pollination system for promoting outcrossing (Coates, 1992).

Interestingly, population 1, which appears to have passed through a "bottle-neck" of perhaps only 3 plants, displays as much genetic variability as the other populations. However, if the species is a disturbance opportunist, its genetic system may be adapted to periodically low numbers followed by rapid population increases. Research into these aspects will continue.

Genetic divergence between the populations at the two disjunct locations has been estimated (Coates, 1992). Wongan Hills populations 1 and 2 clearly separate from the two Maya populations which indicates two genetically distinct management units probably corresponding to different taxa (Fig. 2). The considerable divergence between three Wongan Hills populations is consistent with isolated populations undergoing size fluctuations and genetic drift.

Although the population dynamics of this species is not well understood it is likely that *S. coroniforme* has always had a fragmented population system. Even prior to land clearing localised population extinction of this short lived species probably occurred relatively frequently.

1.5 Threats and impacts

S. coroniforme is vulnerable to local extinction at both of its disjunct localities. Its numbers are low (< 400 known plants) and there are only five populations. Clearing in the central wheatbelt has left fragmented patches, perhaps totalling only 7% of the original vegetation. Remaining populations of indigenous plants are also fragmented. All the known sites have been affected by a number of factors including sheep grazing, gravel extraction, track clearance, road grading.

Although the species may be able to persist over many years at low density, it appears to be a disturbance opportunist. The loss of ground dwelling birds and soil foraging mammals and the consequent loss of soil turnover may have eliminated an important mechanism for initiating regeneration. On the other hand, excessive or inappropriate types of disturbance can be detrimental.

1.6 Strategy and recovery

The most significant recovery action will be the reservation of large parcels of uncleared land in the Wongan Hills area for nature conservation. The water reserve, on which the two largest populations are found, should be re-vested in the National Parks and Nature Conservation Authority (NPNCA), and adjacent land managed by the Department of Agriculture should be added to the proposed reserve. Both areas contain the lateritic habitat favoured by the species. Further searching of these reserves may reveal additional populations, as well as sites for establishing new populations. Germplasm collections for preserving the species against

catastrophic losses is also essential, and knowledge of stored seed longevity is an important part of that program.

Investigating the recruitment biology of *S. coroniforme*, including the longevity of seed under natural conditions, is vital to managing wild populations. Until more is known about the relationship between the Wongan Hills and Maya populations, the latter should be managed as a genetically distinct entity.

2. RECOVERY

2.1 Objectives and criteria

The primary objectives of the Recovery Plan are to secure and where necessary manage the habitat of the larger populations; protect genetically distinct populations; find, protect and manage any other natural populations and if considered appropriate establish new populations in suitable habitat on conservation reserves so that the survival of the species and its genetic diversity is ensured.

The criteria for successful recovery will be:

- 2 years - the land on which the two larger Wongan populations are found will have been gazetted as a Nature Reserve. At least two new populations will be established on the reserve.

- 10 years - all known populations will be stable or increasing, taking into account mature plants, seedlings and the viable seed in any soil seed bank.

2.2 Recovery actions

The enigmatic ecology of *S. coroniforme* is consistent with it being a disturbance opportunist. Thus it may normally exist as a few mature plants or seedlings with occasional population flushes after disturbance events. This poses several questions about correct procedures for maintaining viable populations under natural conditions. However, the following recommendations will ensure the survival of existing populations.

2.2.1 Recovery Team

A recovery team will be appointed to coordinate the implementation of this Recovery Plan. The team will comprise representatives from CALM's Science and Information Division, Nature Conservation Division and Wheatbelt Region, Australian Nature Conservation Agency (ANCA) and others who may be involved in implementing this plan. The recovery team will report annually to CALM's Corporate Executive on the implementation of this plan.

2.2.2 Land Vesting

The protection of as much habitat as possible is one of the most effective steps that can be recommended for the recovery of *S. coroniforme.*

The Water Reserve 16418 (985 ha) contains two healthy populations totalling about 300 plants. It has previously been recommended that the reserve be vested in the NPNCA and the Wongan-Ballidu Shire has supported this proposal.

CALM will continue to negotiate the vesting and management of the water reserve for nature conservation. There are several other threatened and rare flora on the reserve which will benefit from this protection (Table 1). A detailed floristic survey of the water reserve has been conducted (Coates, 1992).

Table 1. Threatened Flora known from Reserve 16418

Declared Rare Flora (Western Australian Wildlife Conservation Act)

Acacia semicircinalis	*Gastrolobium glaucum*
Conostylis wonganensis	*Gastrolobium hamulosum*
Daviesia euphorbioides	*Hemigenia viscida*
Daviesia spiralis	*Stylidium coroniforme*

Priority Taxa (poorly surveyed but considered at risk)

Dryandra pulchella
Dryandra sp. 25 (George 16763)
Hemiandra coccinea

There are other large areas of land adjacent to the water reserve which still carry significant areas of undisturbed native vegetation. One of these is a reserve managed by the Department of Agriculture. CALM is currently seeking to have it included in the Nature Reserve. ESP funds are required to cover expenses directly associated with negotiations but no ESP funds are sought for acquisition of land or compensation costs.

2.2.3 Gravel pit rehabilitation

The large gravel pit in the water reserve is a degraded area with abandoned mounds and hollows harbouring exotic weed species. It will be rehabilitated to protect the large population of *S. coroniforme* which occurs around its periphery. The rehabilitation of this area should involve the authorities responsible for its excavation including Main Roads, Westrail and the Wongan-Ballidu Shire. Nevertheless funding will be required to ensure that it is completed to a high standard. This work will require:-

(a) contouring to stable slopes similar to those occurring naturally in the area;

(b) weed eradication; and

(c) revegetation with local species (two seasons seed collecting and establishment by seed broadcasting).

The work will be supervised by CALM, preferably after the reserve has been re-vested.

If re-vesting is delayed CALM will negotiate with the relevant authorities to ensure that the rehabilitation takes place and that both populations are adequately managed and protected.

2.2.4 Search for additional populations

Further searching in suitable habitat in the Wongan Hills and Maya districts will continue. The discovery in 1991 of the third Wongan Hills population suggests that other undetected populations may still be present. A consultant botanist will be engaged for two seasons during the flowering period to implement this action. The same botanist could be responsible for other actions such as monitoring, management of existing populations and seed biology research (see below).

2.2.5 Monitor and manage existing populations

Existing populations, and any new populations that may be found, will be monitored. Numbers are expected to decline following the initial disturbance. If the number of plants in any population drops below ten reproductive individuals, consideration will be given to further site disturbance to encourage recruitment. This could be carried out without additional cost by the contract botanist required under section 2.2.4.

2.2.6 Establish new populations

If suitable sites are found on the proposed reserve close consideration should be given to the establishment of at least two new populations of *S. coroniforme*. Given the population biology of this species (section 1.4) it is possible that such sites may have contained *S. coroniforme* in the past.

This will involve:

(a) obtaining seed from the two water reserve populations; one or two years (in conjunction with 2.2.5);

(b) searching the proposed conservation reserve for suitable sites for translocations;

(c) mechanically disturbing the site to promote *S. coroniforme* establishment;

(d) spreading seeds in these areas in late summer or early autumn; and

(e) monitoring the populations in following years.

Points (a) to (e) above should replicate the likely events in natural population recruitment, and could lead to further local populations establishing spontaneously. It is probable that past natural disturbances were created by ground bird and mammal activity and fires.

2.2.7 Germplasm storage

Seed from all known populations will be stored in the CALM threatened flora seed centre. Seed will be obtained from wild plants. Viable seed germinates readily but it takes two years for seedlings to flower. The species is known to tissue culture readily and reconstituted plants flower in seven months. However, this a more costly and probably less affective than low temperature seed storage. However Allen Lowrie (pers. comm.) has suggested that nurserymen could be interested in tissue culturing *S. coroniforme* as an export plant novelty. Kings Park and Botanic Garden hold tissue culture material of the species.

It is not recommended that the species be tissue cultured again specifically for germplasm storage. However, the seed store should record information on the origins and availability of tissue cultured lines if these are developed by nurserymen.

2.2.8 Seed biology research

In conjunction with germplasm collections, a research program on *Stylidium* seed biology will be carried out. Methods of setting and harvesting seed from wild and cultivated plants will need to be developed. Information on the natural longevity of seed in the soil is necessary for understanding how the species persists in its habitat. Allied to that, it is important that we understand the mechanisms that trigger natural regeneration. It will also be necessary to know the longevity of seed under storage conditions.

Much of the data will be applicable to other threatened *Stylidium* species currently gazetted as Declared Rare Flora such as *S. galioides* and *S. scabridum.* The work could be undertaken by a consultant botanist. ESP funding support will be needed.

2.2.9 Monitoring and reporting

In addition to the actions described above, there will be an on going need for routine monitoring and assessment of the influence of events that may affect populations. The results will be reported to the recovery team.

(a) monitoring requires annual visits in spring to accurately census plant numbers (adults and juveniles) in the populations at large and in selected quadrats;

(b) reporting significant environmental events such as drought and fire; and

(c) analysing population trends in successive years.

A consultant botanist will be retained for each year of the program.

2.2.10 Public display

Public awareness of *S. coroniforme* is highly desirable. The Wongan-Ballidu Shire will be encouraged to establish a display garden of interesting, rare and endangered species in the region, including *S. coroniforme*. A landscape architect should be engaged to advise on the layout of such a garden.

3. IMPLEMENTATION SCHEDULE

Task	Task Description	Priority	Feasibility	Responsible party		Cost estimate ($000s/Year) 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total	
1.	RECOVERY TEAM	1	100%	CALM, ANCA	b	3	3	3	3	3	2	2	2	2	2	25
2.	LAND VESTING	1	100%	CALM (D, L)	a	1.5	1.5									3
					b	1.5	1.5									3	
3.	REHABILITATING GRAVEL PIT	2	100%	CALM (D), SHIRE													
	3.1 Grading				a		8.5										8.5
					b		1.5									1.5	
	3.2 Weed eradication				a		2.5										2.5
					b		1									1	
	3.3 Revegetation				a	2.5	5	0.5	0.5								8.5
					b		0.5	0.5	0.5							1.5	
4.	POPULATION/HABITAT	1	50%	CONT. BOTANIST,	a	2.5	2.5										5
	SEARCH			CALM (W, S&I)	b	0.5	0.5										1
5.	MONITORING/MANAGEMENT	1	100%	CONT. BOTANIST,	a (See 9 below)												
	EXISTING POPS			CALM (D, W, S&I)	b	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5
6.	ESTABLISH NEW POPULATIONS	2	80%	CONT. BOTANIST,	a		1	1	1								3
		CALM (D, W, S&I)			b		0.5	0.5	0.5								1.5
7.	GERMPLASM COLLECTION	2	50%	CONT. BOTANIST,	a	1	1										2
		CALM (S&I, S)			b	1	0.5										1.5
8.	SEED RESEARCH	2	100%	CONT. BOTANIST,	a		10										10
		CALM (S&I)			b		3									3	
9.	MONITORING	1	100%	CONT. BOTANIST,	a	3	3	3	3	3	2	2	2	2	2	25
		CALM (D, W, S&I)			b	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	5
10.	PUBLIC DISPLAY	3	95%	CALM (W, D),	a	1.5	1.5	0.5	0.5	2							6
			SHIRE		b	0.5	0.5	0.5	0.5	0.5						2.5	
	TOTAL				**a**	**12**	**36.5**	**5**	**5**	**5**	**2**	**2**	**2**	**2**	**2**	**73.5**
					b	**7.5**	**13.5**	**5.5**	**5.5**	**4.5**	**3**	**3**	**3**	**3**	**3**	**51.5**	
																125.0	

a - ESP Funds Required

b - CALM Contributions (W) = Wildlife Branch (S&I) = Science & Information Division (D) = District (L) = Land Administration Branch (S) Silviculture Branch

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