

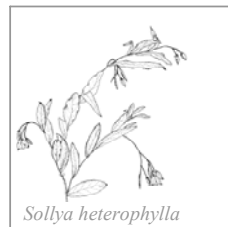
SEARCH FOR SIGNIFICANT SPECIES

GWINDINUP



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1. INTRODUCTION

Bennett Environmental Consulting Pty Ltd was commissioned by Cable Sands (WA) Pty Ltd to undertake a search of their Gwindinup sand mining lease to determine the distribution of Declared Rare Flora, Priority Flora (DRF) and significant species identified on the lease by A. Webb at the Department of Conservation and Land Management, Busselton Office. These were the Declared Rare Flora, *Daviesia elongata* subsp. *elongata*; the Priority 4 Flora (P4) *Caustis* sp. Boyanup; *Daviesia nudiflora* subsp. *nudiflora* believed to be at the most southern extension of its range; *Ricinocarpos cyanescens* and *Logania connii* (soon to be described species) known only from a limited distribution (G.Keighery, pers. comm.) and other species suggested by B. Keighery (pers. comm.) that had been located in surveys at the Dardanup Block.

A. Webb and B. Keighery indicated that the populations of *Daviesia nudiflora* subsp. *nudiflora* located at the lease may be the most southern distribution of this species. This species is common in the Perth metropolitan area but is not recorded in Wheeler *et al.* (2002) as occurring in the Gwindinup area. Dr. D. Backshall when undertaking the original survey of the Bunbury area recorded it from 4 quadrats (D.Backshall, pers. comm.).

A description for the first four species listed below is extracted from FloraBase (Western Australian Herbarium, 2003).



Daviesia elongata subsp. *elongata*.
Spreading shrub, 0.4–1m high. Fl. yellow, orange, red, Dec–Feb. Sandy soils.



Caustis sp. Boyanup. Rhizomatous, clumped perennial, grass-like or herb (sedge), 0.7–1m high. White or grey sand.



Daviesia nudiflora subsp. *nudiflora*. Bushy shrub, 0.3–1.5m high. Fl. orange, yellow, red, brown, Jun–Sep. Sandy & clayey soils, often on laterite. Undulating low rises. Photograph extracted from Western Australian Herbarium 2003.



Ricinocarpos cyanescens. Shrub, 1.2–3m high. Gravel.



Logania conzii. Erect or decumbent, caespitose perennial, herb or shrub, 0.05–0.25m high. Fl. white, Dec–Jan. Sandy & gravelly lateritic soils.

2. METHOD

Two experienced botanists, Dr Eleanor Bennett of Bennett Environmental Consulting Pty Ltd and Dr. D. Brearley of Onshore Environmental Consulting Pty Ltd undertook a search for the above species at the Gwindinup lease between 1st and 3rd December 2003. All drivable tracks

were driven and then transects walked away from the vehicle. Where any of these species were located a GPS reading in WGS84 format recorded the general location.

In addition on the 11th of December a search was made for these in the area between Collins Road, Dillon Road and Twomey Road to the north of Boyanup and in the Sate Forest to the south of the Gwindinup lease. Dr D. Brearley on the 12th December 2003 undertook a search of some of the known locations of *Daviesia elongata* subsp. *elongata* to determine associated soil and species.

3. RESULTS

3.1 Herbarium Records

A search of the records of *Daviesia elongata* subsp. *elongata* and *Ricinocarpos cyanescens* held by the Western Australian Herbarium was undertaken using FloraBase (Western Australian Herbarium, 2003). This is summarised below in Table 1.

Table 1. Location of known populations of *Daviesia elongata* subsp. *elongata* and *Ricinocarpos cyanescens*

INFORMATION	<i>Daviesia elongata</i> subsp. <i>elongata</i>	<i>Ricinocarpos cyanescens</i>
Locality 1	Carbunup townsite reserve	Hithergreen x Haley's Road
Frequency	Locally frequent; 50-100	Not provided
Year of collection	1940, 1953, 1979, 1995, 1996, 2001	1974
Locality 2	Butler Block	Unicup Nature Reserve
Frequency	1000's	Locally common
Year of collection	1998	1997
Locality 3	Smith and Jacka Roads	SW Moodiarrup
Frequency	Abundant where burnt	Occasional in small area
Year of collection	1996, 1997, 1998	1995
Locality 4	Treeton Block	NW Cordering
Frequency	200+ old disturbed tracks	Many plants
Year of collection	1997	2003
Locality 5	Kemp Road, Whicher Range	20km N Kojonup
Frequency	12 where disturbed	No information
Year of collection	1992, 1995, 1996	1985, 1997
Locality 6	Ambergate Reserve	
Frequency	Not provided	
Year of collection	1992	

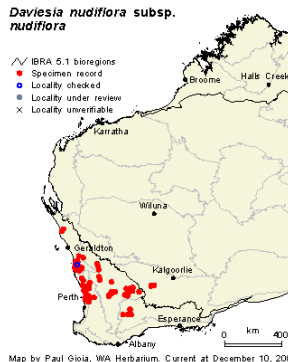
Other data provided on the herbarium sheets included for *Daviesia elongata* subsp. *elongata*:

- Common in disturbed areas eg along tracks, road verges.
- Very common after a fire.
- Recorded from grey sand often overlying laterite, or red-brown or yellowish-brown sandy loam .
- Recorded from flat ground or a gentle slope.
- Occurred in *Eucalyptus* Woodland or *Eucalyptus/Banksia* Woodland with varying understorey species.
- Restricted to two locations on the eastern Swan Coastal Plain (Carbanup and Ambergate) and slopes of Whicher Range (all other locations).

Other data provided on the herbarium sheets included for *Ricinocarpos cyanescens*:

- Generally locally common where it occurs.
- Soil gravel loam.
- Associated with *Eucalyptus* species including *Eucalyptus marginata* and *Corymbia haemotoxylon*.
- Widely distributed recorded from near Busselton to Kojonup.

Daviesia nudiflora subsp. *nudiflora* is common in the bushland near Perth, extends north to Eneabba, northeast to Wubin, east to Yellowdine and southeast to Lake Grace.



Distribution map of *Daviesia nudiflora* subsp. *nudiflora* (Western Australian Herbarium, 2003)

Caustis sp. Boyanup has been recorded from the Whicher Range, Boyanup, Donnybrook and Kojonup in grey sand associated with Banksia or Banksia/Jarrah woodland. Where it has been recorded it is locally abundant.

No information on the distribution etc. is currently available for *Logania connii* except that it has been recorded from the Dardanup Block.

3.2 Gwindinup Lease

Daviesia elongata subsp. *elongata* was only recorded from one area in yellow-orange coloured sand, quite distinct from the common pale grey sand. The plants, over 100 were recorded, occurred scattered through the bushland in a *Corymbia haemotoxylon*, *Eucalyptus marginata* Open Woodland with scattered trees of *Banksia attenuata*, *Banksia grandis* and *Allocasuarina fraseriana* over *Stirlingia latifolia*, *Ricinocarpos cyanescens* and *Daviesia nudiflora* subsp. *nudiflora*. Where *Daviesia elongata* subsp. *elongata* occurred there were always many plants of *Ricinocarpos cyanescens* and several plants of *Daviesia nudiflora* subsp. *nudiflora* also occurring.

Several plants of *Daviesia elongata* subsp. *elongata*, often of larger size were recorded along the track, indicating this is a species, which likes disturbance. Within the mature bushland several dead plants (condition 5) were recorded and only a few were recorded as healthy (condition 1-2). It is anticipated that the number of plants recorded from this area will increase with soil disturbance and/or fire. A few plants of *Daviesia elongata* subsp. *elongata* were recorded from the northern firebreak inside the fence near the gate at the NW corner of Lot M70/900. The disturbed break should be checked next year to determine if any additional plants of this species have germinated. Additional areas of what appeared to be the same soil complex (the yellow-orange sand) and vegetation complex (*Ricinocarpos cyanescens*) were searched but no additional populations were located on the lease.

Ricinocarpos cyanescens was relatively common in the sandy soils in the southern section of the lease, often associated with *Daviesia nudiflora* subsp. *nudiflora* as indicated on the map. Some populations of this species were recorded away from the mine path. This plant was readily identified as it was in flower at the time the survey was undertaken.

Logania connii, a plant 5-10cm tall with white flowers, occurred in lateritic pebble soil typically in *Eucalyptus marginata*, *Corymbia calophylla* Woodland over a Low Shrubland of *Calothamnus sanguineus* and *Hibbertia hypericoides*. The plants were scattered and being so small it was difficult to locate in the dense understorey. All plants recorded were carefully checked to ensure their correct identity, as there were several other species that had a close resemblance.

Daviesia nudiflora subsp. *nudiflora* was recorded from several locations, typically associated with *Ricinocarpus cyanescens*, on white and yellow-orange sandy soils. This also is a species associated with disturbance and the number of plants would be expected to increase with disturbance.

Caustis sp. Boyanup was only located along the verges of Hyder Road south of the junction with Gundagai Road. It was common on both sides of this road and although the adjacent bushland within the lease was searched no additional plants were located. However Cable Sands (WA) Pty Ltd do not intend to mine this area so the plants will not be disturbed as a result of this mining.

The survey of these species was undertaken at the correct time of year as all, except for *Daviesia nudiflora* subsp. *nudiflora* were in flower. *Daviesia nudiflora* subsp. *nudiflora* has a characteristic habit and was readily identified.

Table 2. Location of DRF, P4 and Significant species within the Gwindinup sand mine lease

SPECIES	E	N	NO. PLANTS	COMMENTS
<i>Daviesia elongata</i> subsp. <i>elongata</i>	379803 - 379778 - 379754	6284799 - 6284785 - 6284759	20 plants	
	379745	6284806	5	
	379756	6284756	4	
	379737	6284734	5	
	379726	6284719	6	
	379725	6284627	5	
	379736	6284596	2	
	379736	6284575	1	
	379725	6284552	1	
	379740	6284548	2	
	379774	6284599	2	
	379602	6284771	6	
	379591	6284768	3	
	379552	6284807	1	
	379455	6284529	5	
	379453	6284551	10	
	379523	6284503	4	
	379574	6284510	10	
	379622	6284485	25	
	379602	6284468	3	
	379564	6284440	5	
	379455 - 379564	6284529 - 6284440	30 on tracks	
	379454	6284333	1	
	379488 - 379652	6284821 - 6284816	5 plants on firebreak	
	379779	6284725	1	
	379708	6284823	1	
	379744	6284814	Becoming more frequent along track to west 10 plants in 200m	
379798	6284812	1		
379833	6284815	dead		
379848	6284817	1		
379448	6284528	30+ plants. Complex extends 100m to west. Plants concentrated within 20m of track		
<i>Caustis</i> sp. Boyanup	378353	6284913	Numerous plants	
	378361	6284753	Numerous plants from 1.25km from intersection of Gundagai and Hyder Roads to location as given	
<i>Cyathochaeta teretifolia</i>	379488	6284821	1	
	378353	6284913	1	

SPECIES	E	N	NO. PLANTS	COMMENTS
<i>Logania conii</i>	380923	6286105	10	
	380909	6286062	10	
	389053	6286008	20	
	381167	6285714	15	
	380939	6285584	5	
	380952	6285631	5	
	380860	6284807	10	
	380743	6284790	5	
	380412	6284769	1	
	380410	6284819	1	
	380337	6284790	5	
	379606	6285184	25	
	382122	6288641	5	
	382085	6287642	5	
	382045	6287612	7	
	382151	6287421	>50	Both inside and outside lease but common along the track edge
	381711	6287196	>50	
381482	6286538	2	Below gravel pit	
381463	6286546	>100	Gravel pit on disturbed edge, laterite	
<i>Ricinocarpus cyanescens</i>	380879	6287335	>1000	For 60m along track – in sandy soil
	379803 –	6284821	>>>1000	Associated with <i>Daviesia elongata</i> subsp. <i>elongata</i>
	379652	6284816		
	379525	6285102	>>1000	Scattered on both sides of track
	379563	6285075	>>1000	Dense in area
	379640	6285047	>>1000	Dense in area
	379662	6285053	>>1000	
	379447	6285019		
	379435 –	6285080 –	>>1000	Ricinocarpus common along both sides of track
	379439	6285207		
	379439	6284811	>>>1000	Common to gate
	380682	6286460	>>100	Scattered for 50m along track
	380188 –	6284810 –	>>1000	
	379960	6284808		
379450	6284330		Common in area	
378946 –	6284190 –	>>1000	Occasional plants scattered through area	
378445	6284174			
378356 –	6284488 –	>1000		
378358	6284796			
<i>Daviesia nudiflora</i> subsp. <i>nudiflora</i>	379640	6285073	Ca 10	
	380188 –	6284810 –	Common in area	
	379960	6284808		
	379450	6284330	Common in area	
	378946 –	6284190 –	Common in area	
378445	6284174			

In addition, plants of the Priority 3 species, *Cyathochaeta teretifolia* were located (Table 2). Plants of this species were also located along Brilliants Road when B. Keighery and J. Cole viewed the Gwindinup lease in March 2003.

3.3 Outside of Gwindinup Lease

A search was undertaken on 12th December 2003 to locate additional populations of the species of concern outside of the Gwindinup lease. The GPS records are listed in Table 3. The remnant bushland with sandy soil in the area Collins Road, Dillon Road and Twomey Road north of Boyanup was searched but without success for *Daviesia elongata* subsp. *elongata*, *Daviesia nudiflora* subsp. *nudiflora* and *Ricinocarpus cyanescens*. From the population of *Daviesia elongata* subsp. *elongata* observed on the lease this species was only recorded from the yellow-orange sand and not in the grey

sand but the other two species occurred in either sand. However although a search was undertaken of both sand types, particularly in the Dardanup Reserve none of these species was recorded.

As the *Daviesia elongata* subsp. *elongata* populations recorded in the Department of Conservation and Land Management Herbarium collections occurred to the south of the lease and appeared to be in a line towards the population within the lease a search was undertaken to the south of the lease but within the State Forest. Tracks were driven and specifically selected to cross this sand type. This method resulted in 3 additional populations of *Daviesia elongata* subsp. *elongata*. It would appear from the crossing of the tracks that these populations are very extensive and connect with each other forming a very large population. The plants in these populations were healthier (condition 1-2) than those recorded at the lease population and these areas had been burnt within the last 2 years (pers. comm. Department of Conservation and Land Management, Busselton). The plants at these populations were up to 50cm tall with a spread of 75cm, of larger size than those recorded in the lease. Most plants were flowering and some had developed young fruit.

An additional area of the yellow-orange sand was also searched where large populations of *Daviesia nudiflora* and *Ricinocarpos cyanescens* were located but no additional plants of *Daviesia elongata* subsp. *elongata*. This 'break' in the distribution of this species from the Gwindinup lease to the southern areas may be due to the age of the vegetation since fire or there are two populations separated by a relatively short distance. The Gwindinup lease population may be separate and be of a much lesser number of plants than the population to the south.

Many thousands of *Daviesia nudiflora* subsp. *nudiflora* plants were recorded in the State Forest to the south of the Gwindinup lease. Thus there are many more plants of this species to the south so those on the Gwindinup lease are not the most southern known population.

Ricinocarpos cyanescens was widespread within the Gwindinup lease and was also recorded off but close to the lease. From the search undertaken on the 12th December this species is widespread to the south of the lease and within the State Forest.

No specific search was undertaken for *Logania connii* as it occurred within the laterite areas of the lease most of which will not be disturbed with the proposed mining operation and some of which is to be included in the nominated conservation areas. In addition it was recorded to the north of the Gwindinup lease. *Caustis* sp. Boyanup was not observed during the search.

Table 3. Location of DRF, P4 and Significant species outside of the Gwindinup sand mine lease

SPECIES	E	N	NO. PLANTS	COMMENTS
<i>Daviesia elongata</i> subsp. <i>elongata</i>	377111 – 377446	6281442 – 6281657	>1000	Species still common at limit of search.
	377919 - 378069	6281456 - 6281600	>1000	This population is a continuation of the one above on the same soil type
	378500 378646	6282207 - 6281985	Common in area	This population is a continuation of the two above
<i>Ricinocarpos cyanescens</i>	377692	6283162	>>1000	Along edge of track and between track and Iluka workings
	377477	6282687	Ca 500	
	377488	6282738	Ca 500	
	377285	6282602	>>>1000	Continues for 200m to SW
	377028	6282225	>100	Continues for ca 30m to SW
	377080	6282123	>1000	For 200m to SSE
	377204	6281744	>1000	
	377111 - 377446	6281442 - 6281657	>>1000	
	377919 - 378069	6281456 - 6281600	>>1000	
	378500 - 378646	6282207 - 6281985	>>1000	
	377855	6281298	>100	For 200m NE
379102	6283381	>1000	Continues to the west	

SPECIES	E	N	NO. PLANTS	COMMENTS
<i>Ricinocarpos cyanescens</i> cont.	378779 - 378645	6283350 - 6284069	>1000	Extends about 200m south from track
<i>Daviesia nudiflora</i>	377692	6283162	Several plants	
	377204	6281744		
	377111 - 377446	6281442 - 6281657	>200	
	377919 - 378069	6281456 - 6281600	>100	
	378500 378646	6282207 - 6281985	>100	
	377919 - 378069	6281456 - 6281600		
	378286	6281985	>1000	Continues for 500m SW
	379102	6283381	Several plants	
	378779 - 378645	6283350 - 6284069	>200	Extends about 200m south from track

3.4 Relocation of Herbarium Recorded Sites

Dr D. Brearley on 12th December 2003, relocated the *Daviesia elongata* subsp. *elongata* populations at the Carburnup townsite reserve, Ambergate reserve, Jacka Road and Kemp Road. At these locations the plants were few and scattered through the dense bushland. In addition he located a further population of this species and *Ricinocarpos cyanescens* on Sues Road at 33°46'.04.5"S and 115°25'50.4"E. At each of these locations the plants were recorded in yellow-orange sand associated with *Eucalyptus marginata* Woodland. The Sues Road population of *Daviesia elongata* subsp. *elongata* was the only one where *Ricinocarpos cyanescens* was recorded growing in association. No plants of *Daviesia nudiflora* subsp. *nudiflora* were recorded at these locations.

3.5 Habitat of Significant species

The soil requirements of all the above species were often quite specific. Their potential locations could be determined by the soil type and in the case of sand the colour.

Daviesia elongata subsp. *elongata* was only recorded in yellow-orange sand and was typically associated with *Eucalyptus marginata* often with some trees of *Allocasuarina fraseriana* or *Corymbia calophylla* with the following indicator species near the lease: *Ricinocarpos cyanescens*, *Daviesia nudiflora* subsp. *nudiflora*, *Stirlingia latifolia* and *Synaphea gracilis*. Where the soil became grey in colour and *Hibbertia hypericoides* became the dominant shrub *Daviesia elongata* subsp. *elongata* was no longer located. The plants are sparse and difficult to locate through mature bushland. If the area has been burnt recently the number of plants increases considerably. Senescence of mature plants was observed in the population on the lease but those where the area had been burnt recently (populations immediately south of the lease) were still very healthy.

Daviesia nudiflora subsp. *nudiflora* and *Ricinocarpos cyanescens* typically occurred together in yellow-orange or grey sandy soils. Both plants were healthy in these populations and *Ricinocarpos cyanescens*, some up to 2m tall were still in flower. The *Daviesia nudiflora* subsp. *nudiflora* shrubs were reasonably large, up to 1m tall and often had the tips greying, a feature common with this species.

Ricinocarpos cyanescens also occurred at additional sites, in grey sand, but where neither of the above species was located.

Logania connii was recorded from sandy gravel sites. Again this species appears to be more common where there is disturbance as evidenced at the edge of a gravel pit, indicated in Table 2. It was particularly difficult to locate this species in the denser bushland as it is a small plant, and even when in flower readily overlooked.

All the above species appear to respond to disturbance. There were many *Daviesia elongata* subsp. *elongata* plants along the tracks at both the Gwindinup location and the southern location. Being a pea species, a member of the Papilionaceae, it is common for these species to be colonisers and the large number of plants exhibiting senescence at the Gwindinup population further supports this.

4. DISCUSSION

A search was undertaken of the Cable Sands (WA) Pty Ltd lease at Gwindinup to determine the distribution of the Declared Rare Flora, *Daviesia elongata* subsp. *elongata* and other species indicated as being of significance. The distributions of these species both inside and outside of the lease are mapped in Appendix A using the information obtained in the field.

Daviesia elongata subsp. *elongata* was located in orange sandy soil, very obvious when walking through the bushland as it contrasts markedly with the common grey sand of the area. From the distribution of this taxon recorded during this survey it is anticipated that this taxon is more widespread than currently recorded. Most of the Herbarium records are from readily accessed locations. Additional searches specifically locating the orange sandy soil, particularly after a fire, may increase the recorded distribution of this taxon.

Daviesia nudiflora subsp. *nudiflora* and *Ricinocarpos cyanescens* neither of which are Priority Flora were always associated with *Daviesia elongata* subsp. *elongata* on the Cable Sands mining lease and the area immediately south in the State Forest. It was suggested by A. Webb (pers. comm.) that the plants of *Daviesia nudiflora* subsp. *nudiflora* recorded in the lease might be the most southern of its known distribution. The surveys undertaken during December 2003 located additional populations, typically together, of these three species to the south of the mining lease in the State Forest.

Additional populations of *Daviesia nudiflora* subsp. *nudiflora* and *Ricinocarpos cyanescens* were also located both within and outside of the lease and not in conjunction with *Daviesia nudiflora* subsp. *nudiflora* (see Appendix A). These two species also grow in grey sand whereas no plants of *Daviesia nudiflora* subsp. *nudiflora* were located in this soil.

Logania connii was abundant within the mine lease and in the area immediately off the lease. No detailed search was undertaken for this species off the lease, as most of the locations where this species was recorded are not included in the mine plan.

Other species listed by Keighery *et al.* (2003) as occurring in the Dardanup Block and restricted to the Whicher Range were also searched for both on and off the lease but no additional populations were recorded. At a meeting with G. Keighery, B. Keighery and A. Webb in the State Forest off Gavins Road on 16th November 2003, G. Keighery indicated there may be an undescribed species of *Lomandra* in the area as the soil and vegetation community was similar to where he had previously located it. A description of the habit was provided and throughout all the field work this species was searched for but not located.

5. REFERENCES

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APPENDIX A

Distribution of Significant Species