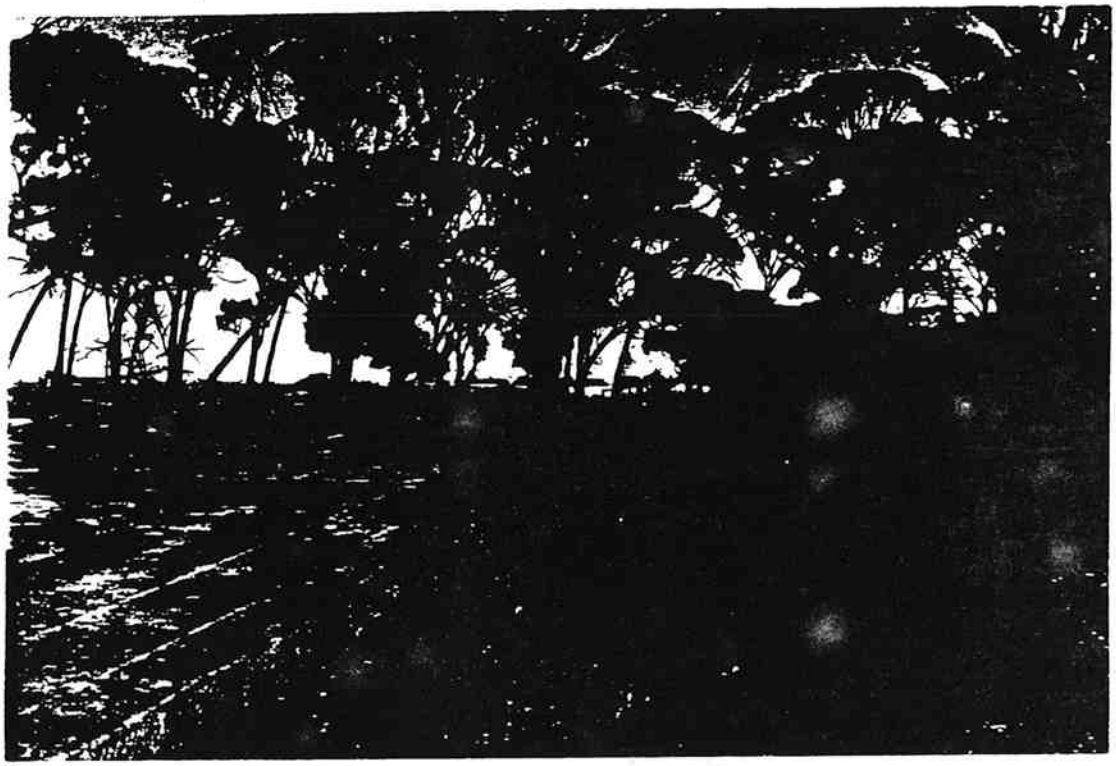
A REVIEW OF THE EFFECT OF KEY DISTURBANCES ON VASCULAR FLORA IN THE SOUTH-WEST FOREST REGION OF WESTERN AUSTRALIA



A Report to the Commonwealth and Western Australian Governments for the Western Australian Regional Forest Agreement

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Note

The authors have indicated that in their view additional time for this project may have enhanced the quality of this report. The Commonwealth and Western Australian Governments welcome any further information or comment from these authors on the matters dealt with in this report, or on additional matters within their area of expertise relevant to the Regional Forest Agreement, within the public consultation period.

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1. INTRODUCTION

The object of this project was to provide an overview of key disturbances impacting on the vascular flora in the south-west forest region of Western Australia (WA). The project is one of a number of consultancies reviewing key disturbances on flora and fauna in the south-west forest region of WA. The other consultancies reviewed the impact of disturbances on non vascular flora species, vegetation communities, invertebrate fauna species, vertebrate fauna species and ecosystem processes.

Disturbances are mechanisms, with the exclusion of death resulting from senescence, which limit the amount of plant biomass by causing its partial or total destruction (Grubb and Hopkins 1986). The impact of a single disturbance event or a disturbance regime on a plant species or community depends on the extent, pattern in space, frequency, intensity and timing of the disturbance(s) (Grubb and Hopkins 1986). The impact of a disturbance or disturbance regime will also depend on the resilience of a species or plant community, that is the processes, life history strategies, by which the species recovers its initial structure and function after a disturbance event (Dell et al. 1986). This study dealt with a range of disturbance events and regimes and the resilience of selected vascular plant species to those events and regimes.

The study focused on human induced disturbances which alter ecosystem processes, such as fuel reduction burning or soil disturbance in roading operations, rather than natural periodic or stochastic disturbances which have been part of the evolutionary history of the south-west vegetation, such as lightning induced fire or severe drought. Disturbances covered varied from complete removal of vegetation such as occurs in farming, utilisation such as in timber harvesting to management practices in conservation areas. The study recognised that:

- single disturbance events have different impacts from either repeated disturbances and combinations of disturbances;
- combinations of human induced and natural disturbances can have severe impacts; and
- some combinations of disturbances have cumulative self reinforcing impacts, such as repeated fire encouraging weed invasion which in turn increases fuel load and thus encourages more frequent burning.

The report provides information on recovery from disturbance where such information was readily available and suggests management actions to ameliorate negative impacts of disturbances identified.

The project was confined to a study of 117 Declared Rare Flora (DRF) and Priority Four Species (P4) in the study area for which information was readily available. Information for other priority species was very poor. This represented a very limited subset of species and for many the information available was also very limited, particularly with respect to biological characteristics. Few species were restricted to forest areas and the study included the surrounding agricultural areas where clearing has had a major impact. The low numbers of Declared Rare Flora in the forest area may indicate that forest practices have not been a major disturbance on forest flora but it is possible that surveys in forest areas have been inadequate and/or that some species have already been lost in the forest but have survived in surrounding areas with different disturbance regimes.

The results of the study will be used in developing reserve design and management options for species and communities, as part of the Western Australia Regional Forest Agreement currently being undertaken jointly by the Commonwealth and Western Australian Governments.

2. METHODS

The project focussed on disturbance effects on key species of vascular flora which occur in the study area. The key species were all DRF and P4 species for which some information was available. A total of 59 DRF and 58 P4 species were investigated. Attempts to include Priority One (P1) and Priority Two (P2) Flora were unsuccessful due to the paucity of available information. By definition P1 and P2 species are poorly known, and many have not even been adequately surveyed despite the fact that they are in some cases regarded as being of equivalent concern as many DRF (D. Papenfus, pers. comm.). Descriptions of conservation codes are provided below.[1] .

Information on each species was gained from a range of sources. Lists of species in the various conservation categories for the study area were obtained from the Department of Conservation and Land Management (CALM) data bases, Wildlife Branch, who also made Flora Files on each species readily available. Other sources of information included regional flora reports, research reports, university Masters and PhD theses as well as experts working in the area. A data base was developed on File Maker Pro to capture and enable sorting of key information on occurrences, disturbance types and life history strategies for each species. A synopsis for each species is included in Appendix 3.

Time restrictions on the project imposed constraints on both the thoroughness and completeness of the research. The study period coincided with the peak spring field survey period and school holidays, making contact with some key scientists difficult or impossible and of shorter duration than desirable. It must also be recognised that the knowledge of many species, particularly of life history strategies and responses to disturbance, is extremely limited. Most reports cover occurrence only, with few recording or analysing ecological attributes or processes. For example, there was virtually no information on pollinators or plant species dependent on forest soil disturbance by native animals which have become locally extinct. As a result of this lack of knowledge, the study was unable to provide the information in the format of functional groups based on a response to disturbance proforma provided by Environment Australia (Appendix 1), which formed one of the initial objectives of the study. This lack of knowledge also represents a barrier to effective recovery actions.

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[1] Conservation Codes

Declared Rare Flora (DRF)
Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

Priority One (P1)
Taxa which are known from one or a few populations which are under threat, either due to small population size, or being on lands under immediate threat, or the plants are under threat. Such taxa are under consideration for declaration 'rare flora', but are in urgent need of further survey.

Priority Two (P2)
Taxa which are known from one or a few populations, at least some of which are not believed to be under immediate threat.

Priority Three (P3)
Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.

Priority Four (P4))
Taxa which are considered to have been adequately surveyed and which, whilst being rare, are not currently threatened by identifiable factors.

The approach adopted was to analyse the data available from the point of view of a series of disturbance regimes and types and then seek to recognise common responses to each disturbance. Three broad Disturbance Regimes were recognised: those associated with Forest Areas; disturbances affecting species in National Parks and Nature Reserves; and those in Agricultural Landscapes. Within each of these Regimes, there were a number of Disturbance Types, such as timber harvesting, fire, disease, weeds, feral animals, grazing, mining, recreation, roading, firebreaks and urban and rural development. In addition, groups of species that shared specific habitats, such as communities on granite outcrops and southern ironstones, were analysed together where they faced common disturbances. It should be noted that the data was analysed on a species basis, and so each species may have had populations within more than one Disturbance Regime and have been subject to a number of different Disturbance Types.

The overall objective was to determine whether the species threatened by a given disturbance exhibited a common response (Appendix 1). This was possible for only a few species due to lack of detailed life history strategies. For a number of site-specific gross disturbances which extensively modify habitats, such as mining and roading, life history strategies of the species were largely irrelevant to survival. In these cases there was no attempt to group species by life history strategies. However, for landscape-scale disturbances such as fire, species life history strategies may be critical for survival and so analysis by life history categories was attempted.

Most species were subject to multiple disturbances, such as as fire, soil disturbance and weeds, the effects of which may be cumulative and self reinforcing. Unfortunately there was little documentation of this phenomenon for the species studied.

Very little information was available on recovery from disturbance, however management actions for recovery have been documented where they have been identified.

The study attempted to synthesise the data and to draw conclusions from the limited species information to the wider study area. This was difficult, as although several studies exist for parts of the wheatbelt region, there has been little comparable scientific study of disturbance and related ecological issues in the south-western forest region. The wheatbelt studies have been used as a basis for discussing the results of the present study where species with similar responses to disturbance and where similar ecological responses would be expected.

3. RESULTS

This project studied reports on 117 species, 59 DRF and 58 P4 species. These are listed, with a synopsis of each species, in Appendix three.

The results are discussed below under the broad Disturbance Regimes: Forests, National Parks and Nature Reserves, and Agricultural Landscapes.

3.1 Disturbances in Forest Areas

Timber harvesting is the most controversial disturbance in forest ecosystems. Harvesting can result in forest fragmentation, structural simplification, modification of natural agents of disturbance such as fire and plant diseases (Peacock, Williams et al. 1997) as well as modifications to species composition.

The following summary of forestry related disturbances is based on the 44 species studied which had populations which occurred in forest areas, of which there were 20 DRF and 24 P4 species. Forest areas included mainly State Forest but also refers to other classes of reserve subject to timber extraction. These 44 species are listed in Table 1, Appendix 2.

3.1.1 Species in forest areas affected by harvesting of timber for logs, pulpwood, craftwood and firewood

Harvesting of timber involves timber felling, log extraction to dumps or landings, burning after harvesting, road construction and road maintenance. Timber felling can alter species compositions depending on regeneration practices and hydrological regimes. Physical removal of timber can remove plant species in the paths of roads, landings and snig tracks. Soil compaction on trafficked areas can reduce establishment of native species on affected areas. Vehicle movement can spread diseases but this issue is considered separately.

The study found that the 6 species in Table 1, Appendix 2, were potentially threatened by timber harvesting related disturbances.

Direct effects

The major disturbances threatening the populations of five of the above species in forest areas were accidental physical disturbance through extraction processes and the construction and maintenance of firebreaks and roads Three species were threatened by firewood and craftwood extraction while 2 species had populations threatened by log extraction in pine plantations. No species were recorded as being threatened by harvesting of sawlogs or pulpwood. The 5 species all reproduced via seeds and some also by resprouting following defoliation. There was no evidence that any of the species were advantaged by forest harvesting related disturbances.

Recovery actions include protection from accidental damage through signage and fencing.

Indirect effects

Some species were affected indirectly by forest harvesting. An example was *Caladenia winfieldii,* which occupies low lying areas and could be affected by water table changes as a result of logging upslope. Buffer areas free of logging are required to maintain water table balances, however the width of buffer requirements are not known.

3.1.2 Species in forest areas affected by fire

Fire has long been part of the environment in the south-west forest region of WA, due to long dry periods and abundant flammable vegetation combined with both natural and human causes. However, pre European fire history is not well understood (Burrows, Ward et al. 1995) and the need to protect assets has led to a managed fire regime with occasional wildfires. The concern is whether the current managed fire regime disturbance has led to decline of vascular plant species.

Fire timing (season), intensity, frequency or return period between fires, and the areal characteristics such as extent and patchiness of the burning all affect vegetation. Lack of fire can also impact on fire dependent species and fire is noted as enhancing recruitment for 9 species in the study, although fire can also form a threat to these species. This study identified a total of 33 species in forest areas for which fire disturbance was a threat (Table 1, Appendix 2). For 20 of these, the information obtained did not specify how fire impacted adversely on the vegetation, and they are not evaluated further, save if firebreak disturbances were an issue.

For the remaining species timing or frequency of burning was identified and these issues are treated separately below. No information was obtained relating to areal aspects of burning.

Species in forest areas affected by frequent fire return periods

Frequent fire was identified as a threat to five species with occurrences in forest areas (Table 1 Appendix 2). Four species, *Asterolasia grandiflora, Kennedia glabrata, Petrophile latericola* and*Thelymitra dedmaniarum,* appear to be killed by fire and are obligate seeders. These species are of concern because they fall within the group of plants most vulnerable to frequent fires, the fire sensitive obligate seeders, either with an already restricted distribution and/or with canopy stored seed (bradysporous species) where the seed bank is exhausted by disturbance (Functional group G, Appendix 1) (Bell, Hopkins et al. 1982). Recurrent fire at an interval equal to or slightly longer than the primary juvenile period can cause gradual attrition of a population of any obligate seed regenerator species leading to eventual extinction in the area subject to the repeated frequent burning (Hopkins 1985). Many *Banksia* species take at least ten years to accumulate seed reserves suitable for adequate post fire recruitment (Cowling, Lamont et al. 1990) and *Banksia verticilata* is known to require more than 20 years (refer section 3.2.3). Hopkins and Griffin (1989) suggest as a rough guide a minimum fire return period of 2.5 to 3 times the time from germination to first flowering if local extinctions are to be avoided. A. Hopkins (pers. comm.) suggests that the primary juvenile period is the time of first flowering of 90% of the population when there is a good chance that all the plants have achieved reproductive maturity. This is often much longer than the time to first flowering of the first few individuals. In the case of *Asterolasia grandiflora* fire interval is recommended to be at least 12 years. For the other species more research is required on species recruitment characteristics.

The above concerns also relate to granite outcrops communities, which are frequently composed of a large proportion of obligate seeders, as compared to jarrah forest which is more resilient to fire (S. D. Hopper pers comm).

Frequent fire is also of concern in the case of some non-clonal species recorded as resprouters. In the case of *Calothamnus graniticus* subsp *leptophyllus* recovery after fire occurs both as resprouts from fire-tolerant mature plants, and the germination of seed. However, seedlings and young plants are killed by fire, so that an ongoing sequence of fires occurring within the juvenile period would eventually be expected to lead to local extinction, with the population becoming polarised as senescent adults and non-seed producing juveniles being killed before they reach maturity.

It is concluded that fire regimes for a given site should be designed to allow for the persistence of those species naturally present at that site, which are most vulnerable to fire. There must be sufficient time between fires for fire sensitive obligate seeders to build up adequate soil and/or canopy borne seed resources to ensure the long term survival of these species at the site. Similarly, if populations are left for extended periods mature individuals may senesce and lead to no recruitment and local extinction is again possible.

Management must also accommodate other disturbances which can effect fire sensitive species, such as a combination of fire with drought, harvesting or grazing occurring repeatedly, simultaneously, or with a short interval between successive events (Griffin and Hopkins 1981; Hopkins and Griffin 1989). For this reason the frequency of burning should be based on continuous monitoring, rather than a fixed time period (Cropper 1993).

Species in forest areas affected by season of burning

Season of burning can affect fire intensity and patchiness and some species are sensitive to burns at critical growth stages. The question of concern is whether the current managed fire regime of spring and autumn fuel reduction burning has led to decline of some vascular plant species.

There is evidence that a hot fire in late summer/autumn results in best seed release, germination and re establishment for some species (Hopkins and Griffin 1989; Cowling, Lamont et al. 1990). It is also understood that burns at cooler times of the year can be patchy and lead to acute impact by herbivores and seed predators, leading to dramatically reduced recruitment (Hopkins and Griffin 1989).

This study found 8 species (Table 1, Appendix 2) for which season of burning was identified as a threat. For 3 species spring burns, when the species are actively growing or flowering, was identified as an inappropriate disturbance, however, for most species the critical time of fire was not stated.

It is concluded that fire management should be designed to maintain the presence of naturally occurring species whose long term survival may be sensitive to particular intensities or timing of burns. For some species at least spring burning is inappropriate.

3.1.3 Species in forest areas affected by firebreaks

Firebreak maintenance is listed as a threat to 14 species in forest areas (Table 1, Appendix 2). For most of these, the response to disturbance is unknown, however *Astroloma* sp Nannup, *Grevillea drummondii* and *Lechenaultia pulvinaris* all appear to be disturbance opportunists for which soil disturbance on firebreaks has enhanced germination.

3.1.4 Species in forest areas affected by mining activities

Sixteen species (8 DRF and 8 P4 species) with at least one population in forest areas were recorded as threatened by disturbances asociated with mining (Table 1, Appendix 2) including gravel extraction, gold, bauxite and sand mining, exploration and roading. Most threats appeared to relate to soil disturbance, but indirect effects such as altered water regimes were also listed.

The species threatened by mining disturbances do not share similar life history characteristics. All appear to be very susceptible to mining processes except

Lechenaultia pulvinaris which, while adults will not survive gross disturbances, is a disturbance opportunist and readily germinates on firebreaks when the soil is disturbed.

Recovery actions identied included not permitting mining where threatened species occur, protection from accidental damage through signage and fencing, and analysis of off-site effects of mining which may affect populations lower in the landscape.

3.1.5 Species in forest areas affected by disease

Fourteen species (Table 2, Appendix 2) with one or more populations in forest areas were recognised as being threatened by disease with dieback (*Phytophthora* sp.) infection having been confirmed for 3 species and 4 species listed as vulnerable due to habitat preferences. Two species of orchid were recorded as being threatened by the secondary effects of dieback in the loss of overstorey species. For 3 species the dieback threat was not specified. A single species was subject to canker as well as dieback. For many cases where "disease" was listed as a threat, specific vulnerability was not known or not stated, but concern extended to the effects of habitat modification due to disease impact on associated species.

In some cases populations were downslope of existing dieback diseased areas and hygiene was considered essential as a recovery action.

3.1.6 Species in forest areas affected by feral animals

Twelve species (Table 1, Appendix 2) in forest areas were potentially affected by disturbance by feral animals, the major impacts identified as coming from rabbits and pigs. In one case wild horses were impacting on a population of one species. Grazing and trampling have a direct impact on species, in particular where grazing follows fire induced regeneration and can impact severely on successful recruitment. Recovery actions must include control of feral animals.

3.1.7 Species in forest areas affected by roadworks

Roadworks potentially affect 20 species with populations in forest areas (Table 1, Appendix 2). One of these species, *Astroloma* sp Nannup, is a disturbance opportunist and may respond to soil disturbance associated with road works. The response to soil disturbance for the other species is not known. Recovery actions for most species must include marking of species locations and protection from roadworks.

3.1.8 Species in forest areas occurring on less common soil types

Some species located within forest areas are found on less common soil types often in non-production forestry vegetation communities not impacted directly by forestry operations. A number of species studied occurred on forest edges adjacent to farmland, and sometimes on the farmland adjacent to forest. This phenomenon appeared to be a result of the alignment of straight forest block boundaries, which included small areas with soil types which carried poorer forest or non forest vegetation communities which have been largely cleared on adjacent private land. Forestry activities such as access tracks, fuel reduction burning, harvesting and disease have the ability to destroy rare flora occurring on such sites.

Where poorer forest or non forest vegetation communities occur on the edges of forest they may have very high conservation value as remnants of vegetation communities that have been largely cleared on farmland. Such cases should be investigated for their conservation value and the adjoining forest areas managed in sympathy where high nature conservation areas occur. Where sites occur on private land adjacent to forest,

their purchase and incorporation into the forest, or another protective mechanism such as a conservation covenant should be considered.

In this study it was not possible to separate these species except with information provided by experts. The following examples are provided from information that was available.

Six species were associated with granite outcrops some occurring in pockets of soil on rock and others on shallow granite or granite derived soils. A variety of disturbance factors affect these sites depending on the situation, including soil removal, roadworks, firebreaks, water table rises associated with mining, spread of dieback and fire regimes. A list of species, from the study area, with populations associated with granite rocks are listed in section 4.3.1. Granite outcrops and their environs require special protection and survey for threatened plants prior to permitting disturbances.

A number of species occur on ironstone communities, some with populations on the edge of forest. These are discussed separately under Disturbances in Agricultural Landscapes - section 3.3.11.

3.2 Disturbances in National Parks and Nature Reserves

National Parks, Nature Reserves are designed to protect flora and fauna and, in the case of National Parks, to provide recreation opportunities. Despite the intent of the parks some species in parks are threatened by a number of disturbances, mainly inappropriate fire, recreation and disease.

Seventy four species studied for this report have occurrences in National Parks, Nature Reserves and in other reserves designated for conservation such as Conservation Parks. Of these 31 are DRF and 43 P4 species (Table 2, Appendix 2).

3.2.1 Species with occurrences in National Parks and Nature Reserves threatened by recreation

Recreation is listed as a threat for 18 species (Table 2, Appendix 2). The threatening disturbances were walking tracks, picnic sites, tourist pressure, access tracks and camping. There was little data on recovery plans but rerouting tracks, fencing and relocating picnic sites appear to be appropriate recovery actions.

3.2.2 Species with occurrences in National Parks and Nature Reserves threatened by disease

Disease, mainly dieback, is listed as a threat for 15 species (Table 2, Appendix 2). For some species the level of threat is suspected but not well understood. Recovery actions include hygiene in many cases and in severe cases maintenance of populations off-site.

3.2.3 Species with occurrences in National Parks and Nature Reserves threatened by fire

The discussion in relation to fire under Disturbances in Forest Areas (section 3.1.2) is equally applicable to National Parks and Nature Reserves. Forty species (Table 2, Appendix 2) in National Parks and Nature Reserves were recorded as being threatened by fire, but for many the exact nature (timing or frequency) of the fire threat was not detailed.

For 7 species season of burning was listed as a threat. Of these species the major threat was spring burning, particularly for species that are dormant in summer and autumn. One species, *Anthrocercis gracilis,* is an obligate seeder which responds well to summer and autumn burns but recruits poorly following spring burning.

For 6 species fire interval or frequency was listed as a threat. Four species were obligate seeders which are killed by fire, fire interval needs to be sufficient to allow rebuilding of seed stocks. *Banksia verticillata* is a bradysporous obligate seeder of granite rocks which is killed by fire. Canopy stored seed stocks for this species require sufficient time to rebuild between fires, a fire free period of more than 20 years is suggested and species on granite rocks appear to need special protection from frequent fire (S. Hopper pers. comm.).

3.2.4 Species with occurrences in National Parks and Nature Reserves threatened by roadworks and firebreaks

Five species (Table 2, Appendix 2) had records of roadworks and firebreak maintenance being threatening disturbances (1 DRF and 4 P4 species). The response to disturbance for 2 species *Astatrea* sp Scott River and *Darwinia thymoides* subsp St. Ronans is unknown but *Astroloma* sp Cataby, *Daviesia microphylla* and *Drosera fimbriata* appear to respond positively to soil disturbance such as firebreak maintenance.

3.3 Disturbances in Agricultural Landscapes

Many species in the study area occur in agricultural landscapes on farmland, road edges, water reserves and shire reserves where there are often only small remnants of the original vegetation communities. The native species in these areas are very vulnerable to deliberate and inadvertent activities which impact on their survival.

The following summary of disturbances in agricultural landscapes is based on 39 species of which there were 28 DRF and 11 P4 species (Table 3, Appendix 2). First a species based summation of the various disturbances and secondly, where species are grouped in vegetation communities facing common threats, plant communities are the basis for discussion (sections 3.3.10 and 3.3.11).

3.3.1 Species in agricultural landscapes affected by grazing

Twenty four species (Table 3, Appendix 2), 17 DRF and 7 P4 species, located in agricultural landscapes are threatened by grazing. The affected species do not share common life history characteristics. Recovery methods recommended include fencing and regeneration, re-establishment elsewhere and markers on roadsides.

3.3.2 Species in agricultural landscapes affected by disease

Nine species (Table 3, Appendix 2), 8 DRF and 1 P4 species, located in agricultural landscapes were potentially affected by disease. The main disease is dieback with one species affected by canker. One species is highly susceptible to dieback, 1 species susceptible to dieback and susceptibility of the other 7 species to dieback is not known. Recovery actions include off-site cultivation and hygiene measures.

3.3.3 Species in agricultural landscapes affected by fire

Twenty eight species (Table 3, Appendix 2), 23 DRF and 5 P4 species, are affected by fire.

Fire return period or fire frequency was recognised as a threat for 7 species. These species were a mixture of obligate seeders and seeders/resprouters. Six species are DRF and exist only in small isolated populations. The concern is that inappropriate fire, particularly frequent fires, could result in extinction of these species. In one case poor communication between the Bush Fires Board and the Shire resulted in inappropriate burning.

Season of burning was listed as a threat for 8 species, 7 of these were *Caladenia* species. The growing period for this genus spans late autumn, winter and spring and fires in spring were listed as threat. The remaining species is *Wurmbea drummondii* which emerges and flowers in winter. In this case spring and early autumn burns are recommended at a minimum of 12 year intervals.

For the remaining species the specific impact of fire was not stated.

It appears important to distinguish between prescribed fuel reduction burning in forest and park areas, which are managed by CALM, and prescribed burning on roadsides and farmland which is controlled by various authorities. On farmland and road edges burning can be for a variety of reasons, often with too little consideration of ecological processes. At least 1 population of a DRF species has been lost due to poor communication between responsible authorities.

The discussion on fire, section 3.1.2, should be referred to in relation to management of fire on farmland and road edges.

For 16 species, 14 being DRF, firebreak maintenance was listed as a threat. Firebreaks often divide bushland from cleared land and farmland from roadside vegetation. Where remnant vegetation is narrow, such as along roads, or where different soils occur on the edges of forest, firebreaks can have a significant impact on the remaining vegetation and impact negatively on threatened species.

Three species, *Chamelaucium* sp Gin Gin, *Darwinia acerosa* and *Lechenaultia pulvinaris* are disturbance opportunists and respond to soil disturbance. Fire break maintenance may favour these species in some circumstances.

Recovery actions for species occupying small areas in exposed locations such as road verges in agricultural landscapes are difficult, due to poor communication within agencies and between agencies, resulting in ad hoc management and inappropriate actions. Clear threatened species delineation and community and agency eduction appear to be the most important recovery actions to ensure reasonable management.

3.3.4 Species in agricultural landscapes affected by feral animals

Eleven species (Table 3, Appendix 2), 10 being DRF, were listed as threatened by grazing by rabbits with other feral animals not listed.

3.3.5 Species in agricultural landscapes affected by weeds

Introduced plants are often better adapted to a combination of physical disturbance, nutrients and weeds than native plants in the wheatbelt (Hobbs and Atkins 1988) and in other areas.

Twenty seven species (Table 3, Appendix 2), 23 being DRF, were affected by weeds. Most of these occurrences were on degraded areas such as road verges subject to physical disturbance and increased nutrients over a long period.

3.3.6 Species in agricultural landscapes affected by fire, disturbance and weeds

Weeds are commonly associated with disturbed areas including many with a history of recurrent fire. Weed invasion often leads to an increase in flammability due to altered fuel characteristics, with repeated burning increasing weeds and reducing nature conservation values in a downward spiral (Hopkins and Griffin 1989). In the absence of other disturbances fire may not necessarily increase weed invasion and fire may be an important management tool for reducing weed competition (Hester and Hobbs 1992).

This study did not find any research or reports on relationships between fire, disturbance and weeds for the species studied.

3.3.7 Species in the agricultural landscape affected by mining

Ten species (Table 3, Appendix 2), 8 being DRF, are found in the agricultural landscape and were threatened by mining. The threats include gravel extraction, 3 species; sand mining, 2 species; exploration, 2 species and adjacent to mine or quarry, 2 species.

3.3.8 Species in the agricultural landscape affected by roadworks

Eighteen species (Table 3, Appendix 2), 14 being DRF, were affected by roadworks. Many of these species occurred as isolated populations on narrow road verges and were very vulnerable to inappropriate road works.

The 18 species do not share similar life histories but three *Chamelaucium* sp Gin Gin, *Darwinia acerosa* and *Daviesia microphyla* appear to be responsive to soil disturbance and may be advantaged in some circumstances.

3.3.9 Species in the agricultural landscape affected by urban and rural development

Five species (Table 3, Appendix 2) were threatened by disturbances associated with urban and rural development. Of the 5 species 4 are DRF and 1 a P4 species.

Two species are threatened by rural subdivision and 3 species by urban subdivision.

There was no information on recovery actions in relation to urban and rural development available.

3.3.10 Species on the Leeuwin-Naturalist Ridge

The Leeuwin-Naturalist Ridge includes 7 species *Caladenia caedarea* subsp. *maritima, Caladenia excelsa, Calothamnus graniticus* subsp. *leptophyllus, Drosera fimbriata, Eucalyptus calcicola, E. phylacis,* and *Wurmea calcicola,* 5 being DRF and 2 being P4 species.

Threats to the species include:

• feral animals	1 species threatened
• recreation activities including tracks, climbers	2 species threatened
• clearing	1 species threatened
• wildflower picking	1 species threatened
• grazing	6 species threatened
• fire	3 species threatened
• weeds	4 species threatened
• firebreaks	1 species threatened
• roadworks	4 species threatened
• rubbish dumping	1 species threatened

No coordinated management approach, or recovery plan, in relation to conservation of threatened species on the Leeuwin-Naturaliste Ridge has been identified.

3.3.11 Species in Ironstone Communities

The Southern Ironstone Communities fall mainly north and south of the south-western portion of the study area in the vicinity of Busselton and Scott River but several DRF and P4 species have occurrences on the edge of the south-west forest region. The Southern Ironstone Communities mainly comprise endemic species restricted to the wet ironstones of the Swan Coastal Plain and Scott Coastal Plain and are mainly present as small occurrences on roadsides and on farms.

This community was ranked as Critically Endangered by CALM. The 11 species were *Brachysema modesta, B. papilio, Chamelaucium royceí, Darwinia ferricola, D.* sp Williamson, *Dryandra nivea* subsp *uliginosa, Grevillea elongata, G. mccutcheonii, Hypocalymna* sp Scott River, *Lambertia orbifolia*, and *Petrophile latericola,* 10 being DRF and 1 being a P4 species.

Threats to the species covering populations inside and outside the study area include:

• feral animals	3 species threatened
• recreation activities including tracks, climbers	5 species threatened
• clearing	2 species threatened
• grazing and cultivation	2 species threatened
• fire	8 species threatened
• weeds	6 species threatened
• firebreaks	3 species threatened
• roadworks	7 species threatened
• rubbish dumping	1 species threatened
• mining, on-site and off-site effects	6 species threatened

The major issues were threat of inappropriate fire, weeds, threat of ad hoc disturbance by roadworks and threats from the sand mining industry. Lack of coordination of activities between agencies has already resulted in losses and severe damage to some populations.

Because the species have minor occurrences on the edge of the study area and because the species are recognised as a Threatened Community by CALM and is managed as a Threatened Community, detailed analysis is not attempted in this report.

3.4 Disturbances Not Identified in the Study

Several disturbances have not been identified for the species in this study but nevertheless could be important. Their lack of identification may be due to the paucity of knowledge of the reproductive processes required by many plants.

3.4.1 Likely disappearance of many species of pollinators, dispersal agents and ground digging fauna

Loss of pollinators was not identified specifically as a threat for any species but 2 species of orchid, *Caladenia winfieldii* and*Caladenia viridescens*, have been artificially pollinated in recent years due to poor seed set in the wild. In the case of *Caladenia winfieldii* , the experimental manipulation has shown that no internal genetic mechanism can account for the low seed set seen in the wild. Orchids were identified as being particularly vulnerable to potential pollinator loss, as their host pollinator relationships are highly specific and the knowledge of their biology and relationships is virtually non existent (S. Hopper, pers. comm.) .

A number of species have been noted as disturbance opportunists responding to road and firebreak maintenance but there has been no indication of how these species survived without artificial disturbance. One species, *Acacia aphylla*, is recorded as being possibly disadvantaged by the lack of disturbance by ground digging mammals and reptiles.

4. DISCUSSION

4.1 Limitations

The study has been only partially successful in providing an overview of the disturbances impacting on the flora of the south-west forest region of WA due to:

- dealing with a small subset of species, many of which have very limited distributions and which may not be representative of the study area;
- poor understanding and documentation of the biological functions and responses to disturbance for the majority of the species;
- little documented ecological assessment or analysis of disturbances, multiple disturbances and their likely impact on particular species;
- paucity of available information on recovery from disturbance for the species studied; and
- limitations on research time.

A significant limitation has been the necessity to treat information at species level rather than deal with individual populations with the result that disturbances are treated as potentially threatening all populations, whereas this may not be the case. For example firebreak maintenance may only affect one population rather than all populations of a species.

The following is a summary of the information from each Disturbance Regime in the format of a discussion of broad Disturbance Types. A summary of special cases focussing on disturbances to three distinctive vegetation communities follows.

4.2 Disturbance Types

4.2.1 Forestry

Direct impacts of forest harvesting

Forest harvesting of timber for craftwood, firewood and Pinus created disturbances which impacted on 5 species through direct impact on the populations. There were no records of sawlog or pulpwood harvesting impacting on threatened species nor evidence that threatened species were advantaged by timber harvesting. Recovery actions identified include protection from accidental damage, signage and fencing.

Indirect impacts of forest harvesting

Forestry activities can also impact on plant communities which are not subject to timber harvesting, for example plant communities on granite outcrops and surrounding granitic soils, and plant communities on ironstone in low lying areas often on the edge of forest. Indirect influences from forestry operations include gravel extraction, roading and water table changes as a result of utilisation upslope eg *Caladenia winfieldii.* Non timber producing forest communities in forest areas often have high conservation values and indirect impacts from forest operations need to be avoided. Recovery actions include maintaining buffer areas around special communities and careful assessment of off-site impacts on threatened species.

4.2.2 Fire

Fire is natural part of the south-west environment but human fire regimes may be impacting on plant species due to possibly increased fire frequency, changes in seasonality, intensity, areal and patchiness effects. Lack of fire can also affect plant communities requiring fire for recruitment.

This study identified 59 species as threatened by fire, 40 of which were DRF and 19 P4 species. Of these 33 species had populations in forest areas, 40 species had populations in National Parks and Nature Reserves and 28 species had populations in agricultural landscapes.

For many species the nature of the threat from fire disturbance was not specified and these species could not be analysed further. For the remaining species, season (timing) and frequency of burning were identified as threats and are discussed below. No information was available relating to areal aspects or patchiness of burning, such as grazing of regeneratiing vegetation in patch burnt areas.

Fire frequency

The species most vulnerable to frequent fires are fire sensitive obligate seeders with seed banks in the soil or in the canopy that are exhausted by fire disturbance. Recurrent fire at an interval which does not allow re-establishment of sufficient stored seed can lead to gradual attrition and elimination of species in the area subject to the repeated fires.

This study identified 5 species with populations in forest areas, 6 species with populations in National Parks and Nature Reserves and 7 species in agricultural landscapes for which repeated fires with short return periods are a threat. In one case a fire return period of at least 12 years is recommended in another case a period greater than 20 years is recommended. For 1 species able to resprout from mature plants, fire kills young plants and frequent fire can therefore eliminate recruitment. The species could be lost should mature plants senesce and die without sufficient recruitment.

Fire regimes should be designed with sufficient time between fires to accommodate the maintenance of fire sensitive obligate seeders present on the site. Fire timing should be based on monitoring, rather than fixed time periods and accommodate other disturbances which can effect fire sensitive species such as drought, harvesting affects and grazing.

Fire timing

Season of burning can affect both fire behavior (intensity and patchiness) and the susceptibility of plant species, with some species being sensitive to fire at certain critical growth stages. Some species appear to require hot fires in late summer/autumn for best seed release and recruitment.

Season of burning is listed as a threat for 8 species with populations in forest areas, seven species with populations in National Parks and Nature Reserves and 8 species with populations in agricultural landscapes. While details of the time of year were not provided for all these species, for a number of species fire at times of growth (spring) is an inappropriate disturbance, particularly for species such as orchids which are dormant in summer and autumn.

Fire management should be designed to maintain the presence of naturally occurring species whose long term survival may be sensitive to particular intensities or timing of fire.

Fire summary

It is apparent that some species are disadvantaged by frequent return times between burns and season of burning, particularly spring burning. There was no information on other fire related burning disturbances such as areal effects. In agricultural landscapes fire is often an *ad hoc* tool used by a range of interests/authorities with little regard for ecological processes and population losses have been experienced in these circumstances. This contrasts with the managed processes (the exception being naturally caused wildfires) as in State Forest, National Parks and Nature Reserves where burning is controlled by a single authority.

It is suggested that burning be responsive to condition of vegetation and the species present rather than being prescriptive. Fire management should be designed to maintain the presence of naturally occurring species, whose long term survival may be sensitive to particular intensities, timing and frequency of burns. Species on distinct soil types such as granite rocks, wet ironstones and poorly drained areas in particular will require very careful fire management if species losses are to be avoided.

4.2.3 Firebreaks and roadworks

The effects of firebreaks and roadworks are similar in that gross soil disturbance by construction can destroy the habitat and more minor activities such as grading and cultivation may destroy individuals and populations. In some cases soil disturbance may result in a flush of germination for species which are soil disturbance opportunists.

This study identified 32 species (22 DRF and 10 P4 species) as being threatened by firebreaks and 35 species threatened by roadworks. Twenty three of these are listed as occurring in forest areas, 8 species for National Parks and Nature Reserves and 28 species in agricultural landscapes.

For most species the response to disturbance by roadworks or firebreaks was unknown. The species threatened by these activities do not share common life history characteristics. The following 8 species appear to be disturbance opportunists where soil disturbance by roadworks or firebreaks has resulted in active recruitment: *Astroloma* sp Nannup, *Grevillea drummondii, Lechenaultia pulvinaris, Astroloma* sp Cataby, *Daviesia microphylla, Drosera fimbriata, Chamelaucium* sp Gin Gin and *Darwinia acerosa.*

Species on roadsides in agricultural landscapes are particularly vulnerable to road and firebreak maintenance. The edges of forest at the forest farm interface, with roads and firebreaks, appear to contain higher occurrences than usual of threatened species, no doubt due to soil/vegetation changes on these boundaries. Recovery actions include delineation and protection of known populations with some species possibly requiring a managed disturbance regime.

4.2.4 Mining

Threats from mining included habitat destruction produced in mining operations and infrastructure establishment, less direct impacts such as firebreak construction and indirect effects such as water table rises or draw down.

A total of 24 species (13 DRF and 11 P4 species) were listed as being threatened by mining. Sixteen species had populations in forest areas and 10 species occurred in

agricultural areas. Mining activities included gold, sand and bauxite mining, extraction of gravel and threats included roading, exploration and modifications to the water table.

The species affected by mining do not share similar life history characteristics. Most of the species studied are disadvantaged although germination for disturbance opportunists, such as *Lechenaultia pulvinaris*, may have increased as a result of soil disturbance such as firebreak maintenance.

Recovery actions include identification and protection of sites where threatened species occur and analysis of potential off-site effects, particularly water table impacts.

4.2.5 Disease

The major disease affecting the threatened species studied was dieback with a single species threatened by canker. A total of 23 species were threatened (18 DRF and 5 P4 species). 14 species had populations in forest areas, 15 species had populations in National Parks and Nature Reserves and 9 species had populations in agricultural landscapes. For some species the susceptibility to dieback is known but for others a threat is suspected but not well understood. Two species were threatened by the secondary effects of loss of overstorey due to dieback and in some cases species occurred downslope from known infected areas.

Suggested recovery actions have been hygiene and maintenance of populations off-site.

4.2.6 Feral animals

Twelve species with populations in forest areas and 13 species with populations in National Parks and Nature Reserves were affected by feral animals. Rabbits were the main threat followed closely by soil modification by pigs and 1 case of wild horses. In the agricultural landscape rabbits were the threat to 11 species. The normal feral animal controls were recommended.

4.2.7 Recreation

Threats arising from recreational activities included the presence of access and walking tracks, picnic sites, camping and trampling by tourists and they affected 18 species with populations in National Parks and Nature Reserves. These species do not share common life history characteristics. There was little information on recovery actions but rerouting tracks, species marking and relocating inappropriate activities are appropriate recovery actions.

4.2.8 Grazing

Twenty four species located in the agricultural landscape were threatened by grazing by domestic stock. The affected species do not share common life history characteristics. Recovery actions include land acquisition, fencing, re-establishment elsewhere and markers on roadsides.

4.3 Special Cases

4.3.1 Granite rocks

Granite outcrops and their environs appear to require special consideration and management, particularly with respect to fire and soil disturbances. Species on granite rocks often require significant intervals between fires, with a fire free period of greater than 20 years recommended for 1 species. Six species with populations on granite rocks in forest areas were subject to a variety of disturbance factors including soil disturbance, spread of dieback and fire regimes.

The following 28 species (17 DRF and 11 P4) were recorded from granite rocks, species: *Acacia aphylla, Acacia cuneifolia* ms, *Anthocercis gracilis, Asplenium aethiopicum, Asplenium obtusatum, Banksia verticillata, Caladenia caesarea* subsp *maritima* ms, *Caladenia harringtoniae* ms, *Caladenia integra, Calothamnus graniticus* subsp *graniticus, Calothamnus rupestris, Darwinia acerosa, Drosera fimbriata, Eucalyptus graniticola* ms, *Eucalyptus phylacis, Grevillea cirsiifolia, Grevillea drummondii, Grevillea flexuosa, Grevillea ripicola, Hemigenia platyphylla, Kennedia glabrata, Kennedia macrophylla, Lasiopetalum bracteatum, Rulingia* sp Trigwell Bridge R Smith s.n., *Sphenotoma drummondii, Thelymitra dedmaniarum, Verticordia fimbrilepis* subsp. *australis* and *Verticordia multiflora* subsp *multiflora.*

4.3.2 Species on the farm forest interface

A number of species studied occurred on forest edges adjacent to farmland. This was apparently a consequence of the original process of forest block selection and survey, which favoured straight roads and boundaries (Keighery pers com), with the result that some patches of non-commercial forest or other vegetation types were included within areas designated as production forest. The soil types associated with these patches have largely been cleared on adjacent lands, so that the patches themselves have become significant remnants rich in endemic species. This argues strongly for the protection and buffering from disturbance of such forest edges where they pass through vegetation communities not well represented in the forest or on farmland. A small number of the species concerned are disturbance opportunists, with germination enhanced by disturbance associated with firebreak and track maintenance.

4.3.3 Leeuwin-Naturaliste Ridge

Seven species in the study found on the Leeuwin-Naturaliste Ridge are subject to a wide range of the threats listed for agricultural landscapes. It is suggested these species be treated as a group when recovery actions are developed.

4.3.4 Ironstone communities

The southern ironstone communities, which contain many endemic species, and although they fall mainly outside the study area, 11 species occurred on its edge. These communities are restricted to a particular soil type and are listed as Critically Endangered by CALM. The threats to these communities are ongoing and should not be underestimated.

4.3.5 Loss of natural processes

The study identified a number of species as disturbance opportunists, however, except for a single case, there was no data on the processes which may have enabled them to persist in the past. These may have included the presence of ground digging native fauna.

Loss of pollinators was not identified as a direct threat for any species although this may be indicative of the current paucity of knowledge rather than reflect the true situation. Two species of orchid which set little seed in the wild, both produced seed after artificial pollination.

The loss of natural processes such as ground disturbance and loss of pollinator vectors will require considerable attention, especially for species in disturbed habitats.

4.3.6 Multiple cumulative disturbances

The study did not identify occurrences of multiple cumulative and self reinforcing disturbances, such as a combination of fire, disturbance and weed invasion. This particular combination is most likely to occur in agricultural areas where the risk of weed invasion is greatest. The lack of data is likely to be the result of lack of research rather than lack of occurrence, and it is important that synergistic effects of several disturbances acting together be understood if recovery plans are to be successful.

5. CONCLUSIONS

This study has had a number of limitations, the most significant of which is the possible lack of representation of the group of species studied. Many of the DRF and P4 species considered occupy particular niches and may never have been widespread. Consequently, the results of the study cannot necessarily be extrapolated to the entire south-west forest region. The study did however make some significant findings in relation to management of disturbance processes which may be applicable to the wider study area. Further research to verify this is warranted.

The key findings were:

Forestry

Forest harvesting can have direct and indirect impacts on ecosystems. Sawlog and pulpwood harvesting was not listed as a threat to the species studied but utilisation of minor forest produce was a threat to 6 species. The greatest impact of harvesting is likely to be on less common plant communities on soil types such as granite outcrops, poorly drained areas and on species near the edges of forests on soil types largely used for agriculture. These communities and species are likely to need carefully designed buffers to protect them from forest operations.

Fire

Fire is listed as a significant threat to nearly half the species studied. Frequent fire was a particular threat to obligate seeder species, particularly those with a seed reserve exhausted by disturbance. Fire intervals must allow time for adequate seed storage to be re-established. Fire free periods of 12 and 20 years were suggested for some species.

The season of fire, particularly spring burning, is a significant issue, particularly for species, such as orchids, whose main growth and flowering period is winter and spring.

Both fire frequency and season are significant issues in ecosystem management. It is concluded that fire management should be responsive rather than prescriptive, and should take into account natural disturbances, which may impact on seed production, such as drought. Fire management should be designed to allow for the persistence of those species, naturally occurring in an ecosystem, which are most vulnerable to fire.

Firebreaks and roadworks

Eight species in the study were identified as disturbance opportunists for which road and firebreaks offered significant recruitment opportunities. There were many other species which were disadvantaged by these activities or for which their response was largely unknown. Species adjacent firebreaks and roads in agricultural landscapes are particularly vulnerable, and in at least two cases population loss was a direct result of lack of clarity in protocol and inadequate training and communication between personnel. Marking and protection of populations of threatened species is required and operations on the forest edges and through poorly represented soil types must be carefully planned to avoid accidental destruction.

Disease

Dieback represents a direct or indirect threat to many species in the study either through the effects on the given species or via habitat modification. For the majority of species, however, dieback susceptibility was suspected rather than confirmed. Research and appropriate protective measures are required for those species, particularly where they are close to dieback-affected areas.

Knowledge base

The life history strategies, disturbance responses and ecological requirements for many species in the study were unknown or at best poorly understood and a number were subject to taxonomic question. A large number of additional species were not included in the study because of an almost complete lack of information. Without broader knowledge of a wider range of species, including the very poorly known P1 and P2 species, the development of effective recovery and management strategies remains difficult, especially where several threatened species occur in a single community or locality.

Further research is required: to determine whether the results of this study are applicable to the south-west forest region; to consider issues such as loss of populations at the ends of species ranges, and the effects of disturbances on species which are more common but which may be subject to particular threats.

Significantly greater resources are required for research into the biologies of threatened species, in addition to basic survey work, to enable effective management of species and their habitats.

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APPENDIX 1

Catagories of functional group based on response to disturbance

DRAFT

Appendix 1: Recommended model attributes for PVA of flora

1 Categories of functional group based on response to disturbance

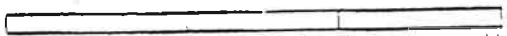
The bars refer to the phases of the taxon's life cycle which are most likely to be present at a site. Infilled bars indicate that the mature phase is able to survive a disturbance event.

Key: juvenile mature propagule

D - obligate seeder, wide dispersal, recovers as juveniles after disturbance

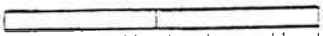
Δ - resprouter, wide dispersal, recovers as mature and juvenile phases after disturbance

σ - obligate seeder, short lived adult, long lived seed bank not exhausted by disturbance, propagules only tend to be present

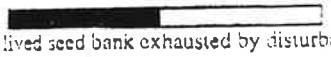


S - obligate seeder, long lived seed bank not exhausted by disturbance, recovers as juveniles after disturbance

Σ - resprouter, long lived seed bank not exhausted by disturbance, recovers as mature and juvenile phases after disturbance



G - obligate seeder, long lived seed bank exhausted by disturbance

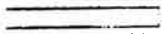


T - resprouter, long lived seed bank exhausted by disturbance

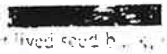
V - vegetative resprouter, no seed bank, mature plants destroyed by disturbance, recovers as juveniles after disturbance

U - vegetative resprouter, no seed bank, mature plants unaffected by disturbance, recovers as mature and juvenile phases after disturbance

ρ - vegetative resprouter, no seed bank, regenerates exclusively from root suckers



C - obligate seeder, short lived seed bank, mature phase only tends to be present



W - resprouter, short lived seed bank, mature phase only tends to be present

N - no mechanism

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APPENDIX 2

Summaries of disturbance types in forest areas (Table 1), National Parks and Nature Reserves (Table 2) and in agricultural landscapes (Table 3)

Table 1. Disturbances affecting species in forest areas

Species	Status	Disturbances								
		Timber harvest	Fire				Mining	Disease	Feral Animals	Roadwork
			Threat not specified	Frequency	Season	Firebreaks				
Acacia anomala	DRF	X				X	X	X		X
Acacia cuneifolia	P4		X							
Adenanthos detmoldii	P4						X			
Anthocercis gracilis	DRF								X	
Asplenium aethiopicum	P4		X							
Astartea sp Scott River (D Backshall)	P4						X	X		X
Asterolasia grandiflora	DRF						X	X		
Asterolasia nivea	DRF		X			X		X	X	X
Astroloma sp Nannup (RD Royce 3978)	P4		X			X				X
Banksia meisnerii subsp ascendens	P4		X			X		X		X
Brachysema modesta	DRF	X				X				X
Brachysema papilio	DRF		X			X	X	X	X	X
Caladenia busselliana ms	DRF	X								X
Caladenia christineae ms	DRF		X					X	X	X
Caladenia dorrienii	DRF		X			X				X
Caladenia harringtoniae	DRF		X				X		X	X
Caladenia winfieldii	DRF	X			X			X	X	
Calothamnus graniticus subsp leptophyllus	P4									
Calothamnus rupestris	P4		X				X		X	
Chamelaucium erythrochlorum	P4									
Darwinia sp Williamson GJK 12717	DRF		X					X		
Dryandra mimica	DRF		X			X				X
Dryandra serra	P4		X					X		X
Eucalyptus aspersa	P4		X				X	X		X
Eucalyptus exilis	P4		X							
Eucalyptus graniticola ms	DRF						X			
Eucalyptus latens	P4						X		X	X

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 1 Disturbances affesting species in forest areas continued

Species	Status	Disturbances								
		Timber harvest	Fire				Mining	Disease	Feral Animals	Roadwork
			Threat not specified	Frequency	Season	Firebreaks				
Franklandia triaristata	P4									X
Gastrolobium glabratum	P4		X							
Grevillea cirsiifolia	P4	X			X	X	X	X		
Grevillea drummondii	P4					X				
Grevillea ripicola	P4									
Hemigenia platyphylla	P4		X							
Kennedia glabrata	DRF			X						X
Lambertia rariflora subsp rariflora	P4									X
Lechenaultia pulvinaris	DRF		X			X	X		X	
Melaleuca basicephala	P4						X			
Meziella trifida	DRF		X							
Petrophile latericola	DRF			X			X	X		
Pimelea rara	DRF	X	X			X	X	X		X
Pultenaea skinneri	P4						X			
Stylidium scabridum	P4		X						X	
Thelymitra dedmaniarum	DRF			X	X	X			X	X
Verreauxia verreauxii	P4		X			X			X	

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 2. Disturbances affecting species in National Parks and Nature Reserves

Species	Status	Disturbances					
		Recreation	Disease		Fire		Roadworks and Firebreaks
				Threat not specified	Frequency	Season	
Acacia aphylla	DRF	X		X			
Acacia clydonophora	P4			X			
Acacia cuneifolia	P4	X		X			
Adenanthos detmoldii	P4						
Anthocercis gracilis	DRF	X				X	
Aotus carinata	P4						
Asplenium aethiopicum	P4	X		X			
Astartea sp Scott River (D Backshall)	P4	X	X				X
Asterolasia grandiflora	DRF		X	X			
Asterolasia nivea	DRF	X	X	X			
Astroloma sp Cataby (EA Griffin 1022)	P4						X
Banksia meisnerii subsp ascendens	P4	X	X	X			
Banksia verticillata	DRF	X	X		X		
Boronia tenuis	P4						
Caladenia bryceana supsp bryceana	DRF	X				X	
Caladenia busselliana ms	DRF	X				X	
Caladenia caesarea subsp. maritima	DRF						
Caladenia christineae ms	DRF		X	X			
Caladenia excelsa	DRF	X		X			
Caladenia harringtoniae	DRF	X		X			
Caladenia integra	P4						
Caladenia interjacens	P4						
Caladenia x triangularis	P4						
Calothamnus graniticus subsp graniticus	P4	X					
Calothamnus pachystachyus	P4			X			
Calothamnus rupestris	P4	X		X			
Chamelaucium roycei	DRF	X			X		X
Conostylis pauciflora subsp pauciflora	P4						
Corybas limpidus	DRF	X		X			X
Darwinia apiculata	DRF	X		X			X

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 2 Disturbances affecting species in National Parks and Nature Reserves continued.

Species	Status	Disturbances					
		Recreation	Disease	Fire			Roadworks and Firebreaks
				Threat not specified	Frequency	Timing	
Darwinia thymoides subsp St Ronans	P4	X					X
Daviesia microphylla	P4	X	X		X		X
Drakea confluens	DRF	X		X			
Drosera fimbriata	DRF						X
Dryandra serra	P4	X	X		X		
Eucalyptus aspersa	P4	X	X	X			
Eucalyptus calcicola	P4						
Eucalyptus exilis	P4			X			
Eucalyptus latens	P4						
Eucalyptus rudis subsp cratyantha	P4						
Eucalyptus sp West Cape Howe	P4						
Franklandia triaristata	P4						
Grevillea cirsiifolia	P4	X	X	X			
Grevillea elongata	DRF	X	X	X			
Grevillea flexuosa	DRF	X					
Grevillea pimelioides	P4						
Hemigenia platyphylla	P4			X			
Hibbertia montana	P4						
Hibbertia silvestris	P4		X	X			
Hypocalymma sp Scott River (AS George 11773)	P4						
Kennedia glabrata	DRF	X			X		
Lambertia orbifolia	DRF		X				
Lasiopetalum bracteatum	P4	X			X		
Laxmannia jamesii	DRF	X		X			
Lechenaultia pulvinaris	DRF	X		X			
Melaleuca basicephala	P4						
Microtis globula	DRF						
Microtis pulchella	P4						
Parsonsia diaphanophleba	P4	X				X	
Pultenaea pauciflora	DRF	X	X	X			
Reedia spathacea	P4						

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 2 Disturbances affecting species in National Parks and Nature Reserves continued

Species	Status	Disturbances					
		Recreation	Disease	Fire			Roadworks and Firebreaks
				Threat not specified	Frequency	Timing	
Restio chaunocoleus	DRF						
Sphenotoma drummondii	DRF		X				
Spirogardnera rubescens	DRF			X			
Stylidium scabridum	P4	X		X			
Tetraria australiensis	DRF			X			
Thelymitra dedmaniarum	DRF	X				X	
Verreauxia verreauxii	P4					X	
Verticordia lehmannii	P4						
Verticordia lindleyi subsp purpurea	P4						
Verticordia multiflora subsp multiflora	P4						
Verticordia plumosa var ananeotes	DRF						
Wurmbea calcicola	DRF	X					
Wurmbea drummondii	P4	X				X	

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 3 Disturbances affecting species in agricultural landscapes

Species	Status	Disturbances										
		Grazing	Disease	Fire				Feral Animals	Weeds	Mining	Road works	Develop ment
				Threat not specified	Return time	Season	Fire breaks					
Acacia anomala	DRF	X	X	X			X		X	X		X
Acacia aphylla	DRF	X		X			X		X			
Acacia cuneifolia	P4	X		X								
Asterolasia grandiflora	DRF	X	X	X						X		X
Asterolasia nivea	DRF		X	X			X	X	X		X	
Brachysema papilio	DRF	X	X	X			X	X		X	X	
Caladenia arrecta	P4					X					X	
Caladenia bryceana supsp bryceana	DRF	X				X	X	X	X			
Caladenia busselliana ms	DRF	X			X	X		X	X		X	X
Caladenia caesarea subsp maritima	DRF					X		X	X			
Caladenia dorrienii	DRF	X				X	X		X		X	
Caladenia excelsa	DRF						X		X		X	
Caladenia viridescens	DRF					X					X	
Chamelaucium roycei	DRF	X			X			X	X			
Chamelaucium sp Gin Gin	DRF						X		X		X	
Darwinia acerosa	DRF	X			X		X	X	X		X	
Darwinia ferricola	DRF	X		X					X	X		
Daviesia microphylla	P4	X			X				X	X	X	
Drakea confluens	DRF	X		X					X			
Dryandra mimica	DRF	X		X			X		X		X	X
Dryandra nivea subsp uliginosa	DRF	X	X	X			X		X	X		
Eucalyptus aspersa	P4	X										
Eucalyptus exilis	P4	X		X								
Eucalyptus rudis subsp cratyantha	P4								X		X	X
Eucalyptus phylacis	DRF		X		X						X	
Grevillea elongata	DRF			X					X		X	
Grevillea maccutcheonii	DRF	X	X		X			X	X			

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

Table 3 Disturbances affecting species in agricultural landscapes continued

Species	Status	Disturbances										
		Grazing	Disease	Fire				Feral Animals	Weeds	Mining	Road works	Development
				Threat not specified	Return time	Season	Fire breaks					
Grevillea saccata	P4			X			X					
Hibbertia miniata	P4	X										
Lechenaultia pulvinaris	DRF			X			X	X	X	X		
Pultenaea skinneri	P4	X								X		
Rinzia crassifolia	P4								X			
Rulingia sp Trigwell Bridge R Smith s.n. 20/6/89)	DRF	X	X		X		X	X	X		X	
Spirogardnera rubescens	DRF	X		X			X		X			
Tetraria australiensis	DRF	X		X					X	X		
Thomasia glabripetala	DRF								X		X	
Tripterococcus brachylobus	DRF											
Verticordia fimbrilepis subsp. australis	DRF			X					X	X	X	
Wurmbea drummondii	P4	X	X			X	X	X	X		X	

This Table is derived from species data, not population data. Not all disturbances will be attributable to the disturbance regime specified in the Table.
DRF- Declared Rare Flora
P4- Priority Four Species

APPENDIX 3

Species list and species synopsis

Explanation of abbreviations in each species synopsis

NR	Nature Reserve
NP	National Park
VCL	Vacant Crown Land
SF	State Forest
X	Indicates a threatening process
p or pop	Population, sometimes population numbers are given
r1, r2 and r3	Level of threat given by others, r3 is high, r1 is low
ns	Not stated

Community descriptions eg heathland A over low sedges B are a modification of Muir's classification as outlined by B. Keighery in Bushland Survey Guide, Wildflower Society of Western Australia

Species List for a Review of the Effect of Key Disturbances on Vascular Flora in the South-West Forest Region of Western Australia

Genus	species	Status
Acacia	anomala	DRF
Acacia	aphylla	DRF
Acacia	clydonophora	P4
Acacia	cuneifolia ms	P4
Adenanthos	detmoldii	P4
Adenanthos	X pamela	P4
Anthocercis	gracilis	DRF
Aotus	carinata	P4
Asplenium	aethiopicum	P4
Asplenium	obtusatum	DRF
Astartea	sp Scott River (D Backshall)	P4
Asterolasia	grandiflora	DRF
Asterolasia	nivea	DRF
Astroloma	sp Cataby (EA Griffin 1022)	P4
Astroloma	sp Nannup (RD Royce 3978)	P4
Banksia	meisneri subsp ascendens	P4
Banksia	verticillata	DRF
Boronia	tenuis	P4
Brachysema	modesta ms	DRF
Brachysema	papilio	DRF
Caladenia	arrecta ms	P4
Caladenia	bryceana subsp bryceana ms	DRF
Caladenia	busselliana ms	DRF
Caladenia	caesarea subsp. maritima ms	DRF
Caladenia	christineae ms	DRF
Caladenia	dorrienii	DRF
Caladenia	excelsa ms	DRF
Caladenia	harringtoniae ms	DRF
Caladenia	integra	P4
Caladenia	interjacens ms	P4
Caladenia	viridescens ms	DRF
Caladenia	winfieldii ms	DRF
Caladenia	x triangularis	P4
Calothamnus	graniticus subsp graniticus	P4

Genus	species	Status
Calothamnus	graniticus subsp leptophyllus	P4
Calothamnus	pachystachyus	P4
Calothamnus	rupestris	P4
Chamelaucium	erythrochlorum	P4
Chamelaucium	roycei	DRF
Chamelaucium	sp Gin Gin	DRF
Conostylis	pauciflora subsp pauciflora	P4
Corybas	limpidus	DRF
Cyanicula	ixioides subsp ixioides	P4
Darwinia	acerosa	DRF
Darwinia	apiculata	DRF
Darwinia	ferricola ms	DRF
Darwinia	sp Williamson (GJ Keighery	DRF
Darwinia	thymoides subsp St Ronans	P4
Daviesia	microphylla	P4
Drakea	confluens ms	DRF
Drosera	fimbriata	DRF
Dryandra	mimica	DRF
Dryandra	nivea subsp. uliginosa ms	DRF
Dryandra	serra	P4
Eucalyptus	aspersa	P4
Eucalyptus	calcicola	P4
Eucalyptus	exilis	P4
Eucalyptus	graniticola ms	DRF
Eucalyptus	latens	P4
Eucalyptus	phylacis	DRF
Eucalyptus	rudis subsp cratyantha	P4
Eucalyptus	sp West Cape Howe	P4
Frankenia	glomerata	X
Franklandia	triaristata	P4
Gastrolobium	glabratum ms	P4
Grevillea	cirsiifolia	P4
Grevillea	drummondii	P4
Grevillea	elongata	DRF

Genus	species	Status
Grevillea	flexuosa	DRF
Grevillea	mccutcheonii ms	DRF
Grevillea	pimelioides	P4
Grevillea	ripicola	P4
Grevillea	saccata	P4
Hemiandra	rutilans	DRF
Hemigenia	platyphylla	P4
Hibbertia	miniata	P4
Hibbertia	montana	P4
Hibbertia	silvestris	P4
Hypocalymma	sp Scott River (AS George	P4
Kennedia	glabrata	DRF
Kennedia	macrophylla	DRF
Lambertia	echinata sub occidentalis	DRF
Lambertia	echinata subsp. echinata	DRF
Lambertia	orbifolia	DRF
Lambertia	rariflora subsp rariflora	P4
Lasiopetalum	bracteatum	P4
Laxmannia	jamesii	DRF
Lechenaultia	laricina	DRF
Lechenaultia	pulvinaris	DRF
Leptomeria	dielsiana	X
Melaleuca	basicephala	P4
Meziella	trifida	DRF
Microtis	globula	DRF
Microtis	pulchella	P4
Parsonsia	diaphanophleba	P4
Petrophile	latericola ms	DRF
Pimelea	rara	DRF
Pultenaea	pauciflora	DRF
Pultenaea	skinneri	P4
Reedia	spathacea	P4
Restio	chaunocoleus	DRF
Rinzia	crassifolia	P4

Genus	species	Status
Rulingia	sp Trigwell Bridge R Smith s.n.	DRF
Sphenotoma	drummondii	DRF
Spirogardnera	rubescens	DRF
Stylidium	scabridum	P4
Tetraria	australiensis	DRF
Thelymitra	dedmaniarum	DRF
Thelymitra	stellata	DRF
Thomasia	glabripetala	DRF
Tripterococcus	brachylobus ms	P4
Verreauxia	verreauxii	P4
Verticordia	fimbrilepis subsp. australis	DRF
Verticordia	lehmannii	P4
Verticordia	lindleyi subsp purpurea	P4
Verticordia	multiflora subsp multiflora	P4
Verticordia	plumosa var ananeotes	DRF
Wurmbea	calcicola	DRF
Wurmbea	drummondii	P4

Species Synopses for a Review of the Effect of Key Disturbances on Vascular Flora in the South-West Forest Region of Western Australia

Acacia anomala CA Gardner ex Court

Status DRF **Flowers** Aug-Sep **Populations** 13 **Family** Leguminosae

Distribution

Darling Scarp: Kalamunda, Pickering Brook, Bullsbrook.

Habitat

Open forest over shrubland over open heath or dense low heath; Low woodland A

Eucalyptus marginata, Eucalyptus calophylla, Allocasuarina fraseriana over*Xanthorrhoea, Hakea, Banksia. grandis, Persoonia*

Confined to laterite soils: loam over sandy loam over clayey sand, hard packed gravel limiting layer. Yellow sandy gravel over laterite; one population saline peat.

Threats Identified

Fire	X prescribed burning, wildfire	**Clearing**	
Logging	X firewood collection	**Firebreaks**	X r3
Mining	X- gravel	**Feral animals**	
Disease	X- nonspecific ; downslope of PC infected	**Insects**	
Agriculture	X grazing ; grazing control r2	**Weeds**	X ns
Urbanisation	X road being widened for subdivision	**Wildflower harvesting**	
Recreation	X motor bikes, walk trail		

Other X Roadworks, road grading, spoon drains, rubbish dumping, firewood collection, SEC powerline breaks

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Unknown

Susceptibility to Phytophthora

Unknown

Remedial actions

Fencing, restrict firebreak maintenance, weed and rubbish removal; liaise with shires etc for accidental destruction, acquire land, rare flora markers, protect from grazing, collect seed, establish in cultivation, do not burn.

Notes

Recovery Plan completed 1992

Sources

Coates 1989, Coates *et al* (1988), Briggs and Leigh (1996), Kelly *et al* (1990), Hopper *et al* (1990); S. Patrick pers. comm.

Acacia aphylla Maslin

Status DRF **Flowers** Aug-Sep **Populations** **Family** Leguminosae

Distribution

Restricted to granite outcrops in woodlands or forests, grows in crevices; Darling Range near Perth, and near Northam, Hidden Valley, Spencers Brook ; Mokine Nature Reserve; Clackline NR

Habitat

Woodland over low heath D or C; Wandoo,open Marri/Wandoo woodland; Open paddock with scattered Marri, Wandoo. Jam. *Allocasuarina heugeliana.*

Allocasuarina heugeliana, Xanthorrhoea preissii, Acacia accuminata, Acacia. lasiocalyx, Stypandra glauca, Borya nitida, Drosera sp.;Trymalium ledifolium, Dryandra sessilis.

Sand & loam over granite outcrop & granitic rubble; Granite boulders & fulviatile gravel with dark yellow clay loam; Saline dark yellow clay loam, upland slope, sited high in overall landscape.

Threats Identified

Fire	X prescribed burns; fire exclusion r2	**Clearing**	X SEC clearing
Logging		**Firebreaks**	X r2
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing r2	**Weeds**	X not stated
Urbanisation		**Wildflower harvesting**	
Recreation	X vehicle, horse; r2		
Other	X pop size r1		

Response to Disturbance

Response to fire

Killed by fire/reseeds; numerous seeds germinate after hot summer burn.

Response to soil disturbance

Unknown; germination most pronounced after disturbance

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Autumn burns at minimum of 12 yearly intervals to allow regeneration from seed and flowering; acquisition of land should be given high priority.

Notes

Seedling recruitment low, germination not enhanced by fire, flowers after 2nd year, dies off after 4-5 years, germination most pronounced after disturbance eg roos, seed with eliaosome, probably ant distributed, may need specific type of disturbance. A aphylla may have benefited from disturbance activities of small native vertebrates, both mammals and reptiles, which are now uncommon or extinct locally.

Sources

Briggs and Leigh (1996), Kelly *et al* (1990), Hopper *et al* (1990), Robson (1996) IUCN (1978); Sue Patrick pers. comm.

Acacia aphylla Maslin

Status DRF **Flowers** Aug-Sep **Populations** **Family** Leguminosae

Distribution

Restricted to granite outcrops in woodlands or forests, grows in crevices; Darling Range near Perth, and near Northam, Hidden Valley, Spencers Brook ; Mokine Nature Reserve; Clackline NR

Habitat

Woodland over low heath D or C; Wandoo,open Marri/Wandoo woodland; Open paddock with scattered Marri, Wandoo. Jam. *Allocasuarina heugeliana.*

Allocasuarina heugeliana, Xanthorrhoea preissii, Acacia accuminata, Acacia. lasiocalyx, Stypandra glauca, Borya nitida, Drosera sp.;Trymalium ledifolium, Dryandra sessilis.

Sand & loam over granite outcrop & granitic rubble; Granite boulders & fulviatile gravel with dark yellow clay loam; Saline dark yellow clay loam, upland slope, sited high in overall landscape.

Threats Identified

Fire	X prescribed burns; fire exclusion r2	**Clearing**	X SEC clearing
Logging		**Firebreaks**	X r2
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing r2	**Weeds**	X not stated
Urbanisation		**Wildflower harvesting**	
Recreation	X vehicle, horse: r2		

Other X pop size r1

Response to Disturbance

Response to fire

Killed by fire/reseeds; numerous seeds germinate after hot summer burn.

Response to soil disturbance

Unknown; germination most pronounced after disturbance

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Autumn burns at minimum of 12 yearly intervals to allow regeneration from seed and flowering; acquisition of land should be given high priority.

Notes

Seedling recruitment low, germination not enhanced by fire, flowers after 2nd year, dies off after 4-5 years, germination most pronounced after disturbance eg roos, seed with eliaosome, probably ant distributed, may need specific type of disturbance. *A aphylla* may have benefited from disturbance activities of small native vertebrates, both mammals and reptiles, which are now uncommon or extinct locally.

Sources

Briggs and Leigh (1996), Kelly *et al* (1990), Hopper *et al* (1990), Robson (1996) IUCN (1978); Sue Patrick pers. comm.

Acacia clydonophora

Status P4 **Flowers** April-Nov **Populations** 3 **Family** Leguminosae

Distribution

Gravel reserve & adjacent NR, Cataby; Yandan NR, Bonnanarring NR; main populations in Gairdner Ra and Leseuer NP.

Habitat

Low Eucalyptus woodland or high open shrubland over low heath.

Xanthorrhoea, Eucalyptus calophylla, Dryandra sp.

Laterite or sandy loam over laterite; on ridges or in gullies

Threats Identified

Fire	X Wannamal- burning by neighbours	**Clearing**	X Wannamal
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); Burbidge *et al* (1996); Maslin (1995); GJ Keighery, N Gibson, S. Patrick pers comm

Acacia cuneifolia ms Maslin

Status P4 **Flowers** Sept-Oct **Populations** 13 **Family** Leguminosae

Distribution

Boyagin NR and adjacent PP ; Wandoo Conservation Park. Little Darkin Swamp; most populationas in Cons park in Gunapin Block; Mt Talbot.

Habitat

Very open stand of Allocasuarina heugeliana LA.i.r. SA.SB. SC.SD. c.i.r.

Xanthorrhoea, Acacia pulchella, Gastrolobium spinosum ; occasional powderbark wandoo & Marri.

high in landscape, sheer granite outcrop; 1 population in inundated swamp, sand & clay

Threats Identified

Fire	X prescribed burning	**Clearing**	X Boyagin
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing Boyagin Rock	**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X Boyagin , Mt Talbot		
Other			

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Not stated

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996).

Adenanthos detmoldii F. Muell.

Status P4 **Flowers** Aug-Nov **Populations** 18 **Family** Proteaceae

Distribution

Scott Plain, Nillup Plain, Scott R, Karridale, Alexander Br; in State Forest , road reserves, nature reserves, water reserves, private property.

Habitat

Heath or sedgeland; tall sedges over low heath D.

Leptocarpus scarious, Pericalymma ellipticum.

Winter wet flats; grey sand over clay.

Threats Identified

Fire

Logging

Mining X Gingilup swamp

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

killed

Establishment

Unknown

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Monitor verge pops, confirm pop at Black Pt, 2 pops on reserved lands.

Notes

Status of taxon on Scott R plain uncertain- only two substantial populations on reserved land in eastern end of range; attempt to secure reserves on western end.

Sources

Keighery & Robinson (1992), Leigh *and Briggs*); GJ Keighery pers. comm.

Adenanthos X pamela

Status P4 **Flowers** **Populations** **Family** Proteaceae

Distribution

occurs wherever *A. detmoldii* and *A. obovata* meet in disturbed habitat.

Habitat

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other
Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Killed by fire/reseeds
Response to soil disturbance
Germination enhanced.
Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources
Keighery & Robinson (1992); GJ Keighery pers. comm.

Anthocercis gracilis

Status DRF **Flowers** Feb- Oct. bulk **Populations** 7 **Family**

Distribution

Mundaring Weir, North Dandalup, John Forest NP; Helena valley, Bickley Brook Reserve, Marrinup Forest Block.

Habitat

Heath under *Allocasuarina* woodland, *Allocasuarina & Eucalyptus calophylla.*

Allocasuarina heugelii, X preissii, Trymalium ledifolium, Xanthosia heugeliana .

Granite boulder scree, yellow or dark brown loam.

Threats Identified

Fire X timing p5e 5f

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation X pops3, 5- walking track, p4 picnic site,

Other X pig diggings, possibly grazed by Kangaroos

Clearing

Firebreaks

Feral animals X pigs p1

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Fire dependent

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Population at Oakley dam 50+ plants after fire, 6 plants before.
Self incompatible, capsule set low but seed/caps high. Started flowering 2nd spring after fire substantial seed bank built up between fires.

Sources

Briggs and Leigh (1996), Stace (1995), Stace and Patrick (1995, 1993), S. Patrick pers. comm.

Aotus carinata Meisn.

Status P4 **Flowers** Sep-Nov **Populations** **Family** Leguminosae

Distribution

Scott Plain Black Pt to Blackwood R. Scott NP & SF boundary.

Habitat

Low woodland or low to tall heath, both over sedges.

Melaleuca preissiana; Evandra aristata; Beaufortia sparsa, Homalospermum sp.

In or around winter wet flats peaty sandy clay over clay on low plain.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining	X	**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X grading of drain back slopes

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Well conserved, numerous populations.

Sources

Keighery and Robinson (1992), Leigh *et al* (); GJ Keighery pers. comm.

Asplenium aethiopicum (Burman.)Bech

Status P4 **Flowers** - **Populations** 1 pop **Family** Aspleniaceae

Distribution

Porongurup NP ; Flow guage stationn Denmark; Mt Lindesay; Stirling Range National Park; Willyung Hill; granite outcrops adjacent to Mt Burnside and S of Warriup Hill.

Habitat

Moss in sheltered crevices ; dwarf scrub C; among fern clumps in Porongurups & low herbs at Willyung Hill.

Pterostylis aff nana ; Lepidosperma gladiatum, Stypandra; Mt Magog- *Calothamnus, Kunzea montana.*

Granite outcrops and boulders in sand.

Threats Identified

Fire X prescribed burning

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation X Mt Hallowel

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* (1990).

Astartea sp Scott River (D Backshall)

Status P4 **Flowers** Dec-Jan **Populations** **Family** Myrtaceae

Distribution

Scott Plains from Black Pt to Blackwood R : D'Entrecasteaux NP, Scott R NP; State forest/vacant crown land, road verge; L Jasper; Brockman Hwy; Black Pt Rd N of Black Pt.

Habitat

Shrubland or heath, rarely with emergent Paperback; dense heath B over tall sedges; Melaleuca preissiana low open woodland; swamp heath; Dense low heath d and low sedges.

Melaleuca (rare), *Evandra aristata; Astartea aff fascicularis; Eutaxia virgata, Aotus intermedia,*

Winter-wet flats and swamps in sandy soils over clay.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining	X Black Pt Rd; N side of Scott R Rd	**Feral animals**	
Disease	X	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X cars		

Other X road construction- to family car standard in D'Entrecasteaux NP

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery & Robinson (1992); GJ Keighery, N Gibson pers comm

Astartea sp Scott River (D Backshall)

Status P4 **Flowers** Dec-Jan **Populations** **Family** Myrtaceae

Distribution

Scott Plains from Black Pt to Blackwood R : D'Entrecasteaux NP, Scott R NP; State forest/vacant crown land, road verge; L Jasper; Brockman Hwy; Black Pt Rd N of Black Pt.

Habitat

Shrubland or heath, rarely with emergent Paperback; dense heath B over tall sedges; Melaleuca preissiana low open woodland; swamp heath; Dense low heath d and low sedges.

Melaleuca (rare), *Evandra aristata; Astartea aff fascicularis; Eutaxia virgata, Aotus intermedia,*

Winter-wet flats and swamps in sandy soils over clay.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining	X Black Pt Rd; N side of Scott R Rd	**Feral animals**	
Disease	X	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X cars		

Other X road construction- to family car standard in D'Entrecasteaux NP

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery & Robinson (1992); GJ Keighery, N Gibson pers comm

Asterolasia grandiflora (Hook)Benth.

Status DRF **Flowers** Jul-Oct **Populations** 7 **Family** Rutaceae

Distribution

Toodyay to York: Wongamine NR. Mokine NR , gravel reserve, private land, rural subdivision and Flynn SF .

Habitat

In thick scrub in open *Eucalyptus accedens* woodland.

Eucalyptus accedens, Eucalyptus calophylla, Eucalyptus drummondii, Dryandra, Xanthorrhoea, Leptospermum.

Brown gravelly loam between lateritic boulders high in landscape and on breakaways.

Threats Identified

Fire	X exclusion r1, p7 p1 active extraction	**Clearing**	
Logging		**Firebreaks**	
Mining	X gravel reserve near York. r3	**Feral animals**	
Disease	X Phytophthora cinnamomi hygiene r2	**Insects**	
Agriculture	X grazing: r2	**Weeds**	
Urbanisation	X pop 6- clearing	**Wildflower harvesting**	
Recreation			

Other X accidental destruction

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Tolerant or opportunist; apparently requires unshaded or disturbed sites for germination

Establishment

Disturbance opportunist; seedlings more evident in cleared and disturbed areas

Susceptibility to Phytophthora

Unknown

Remedial actions

Autumn burns only at minimum 12 year intervals

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); GJ Keighery, N. Gibson, S. Patrick pers comm

Asterolasia nivea (Paul G Wilson) Paul G Wilson.

Status DRF **Flowers** Aug-Oct **Populations** **Family** Rutaceae

Distribution

Bindoon: Flat Rock Gully Reserve, Road Reserve, SF Gallagher Block ; three transplanted populations at Udumung NR.

Habitat

Open *Eucalyptus drummondii/ Eucalyptus wandoo/ Eucalyptus calophylla* woodland over heath

Allocasuarina. humilis, Adenanthos cygnorum, Dryandra polycephala, Grevillea synapheae.

Brown gravelly loam with lateritic rocks on breakaways.

Threats Identified

Fire	X Shire burns; level 3 p3	**Clearing**	
Logging		**Firebreaks**	X level 3 , firebreak
Mining		**Feral animals**	X rabbits digging
Disease	X dieback hygiene level 3	**Insects**	
Agriculture	X herding of animals	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X level 3 picnickers		

Other X roadworks; pop size level 3 ; people drive over verge

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Seedlings come up in gutters on road edge

Establishment

Susceptibility to Phytophthora

Susceptible

Remedial actions

Protective autumn burn to adjacent roadside vegetation

Notes

Autumn burn May 1994: plot had 11 mature plants, 72 seedlings, no regrowth from roots 1995; slow growing, burnt '93 possibly flowering 96 or 97.

Sources

Briggs and Leigh (1996), Patrick in Leigh and Briggs (1992), Kelly *et al* (1990), Hopper *et al* (1990); D. Papenfus, GJ Keighery, N. Gibson, S. Patrick pers. comm.

Astroloma sp Cataby (EA Griffin 1022)

Status P4 **Flowers** Feb-Jul **Populations** 9 **Family** Epacridaceae

Distribution

Calingiri, Bindoon Army Training Area, Coomalloo; Leseuer NP- Mt Peron
Mt Benia, Seven Mile Well NR, road reserve.

Habitat

Open wandoo or marri woodland over low open scrub; or mixed shrubland.

Hakea over papilionaceous shrub layer; *E wandoo, E calophylla, E marginata* with *Hakea trifurcata, Gastrolobium spinosum, Hibbertia lasiopus.*

Grey brown sand or brown loam over laterite with boulders.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire
Killed by fire/reseeds

Response to soil disturbance
Germination enhanced, encouraged by grading

Establishment
Disturbance opportunist

Susceptibility to Phytophthora
Presumed susceptible

Remedial actions

Notes

Sources
Briggs and Leigh (1996), S. Patrick pers. comm.

Astroloma sp Nannup (RD Royce 3978)

Status P4 **Flowers** Apr-Jun **Populations** 20 **Family** Epacridaceae

Distribution

Nannup, Karridale, Augusta & Scott Coastal Plain: verges, shire reserve.

Habitat

Mallee heath : woodland; forest; on edge of jarrah/marri forest in understorey of Proteaceae.

E marginata E calophylla; Melaleuca sp, Thysanotus sp, Patersonia sp.; Hibbertia hypericoides, Sphaerolobium medium, Hybanthus debilissimus.

clay over lateritic clay; grey sand; lower slope, sandy surface.

Threats Identified

Fire	X prescribed burning	**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks- verge populations

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Germination enhanced

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Banksia meisneri subsp ascendens

Status P4 **Flowers** Mar-Aug **Populations** 8 **Family** Proteaceae

Distribution

Ruabon to NW of Black Pt; Whicher Ra, Scott R Plain (National Park); Abba, Hilliger SF Block; verge.

Habitat

Low woodland , jarrah low woodland, heath, sedgeland, heath over sedges.

Banksia ilicifolia; Eucalyptus marginata

Sandy clay wet flats beside clay. 1996; natural drainage line; Nannup: hilltop black sand, per wet.

Threats Identified

Fire	X prescribed burns	**Clearing**	X Scott R
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease	X PC the major threat. Dieback impacting	**Insects**	
Agriculture		**Weeds**	X low on wet SP
Urbanisation		**Wildflower harvesting**	
Recreation	X		
Other	X roadworks		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Population at Ruabon decreased by 50% 1991-1996

Sources

Briggs and Leigh (1996), Keighery & Robinson (1992); GJ Keighery, N Gibson, S Patrick pers comm

Banksia verticillata R.Br

Status DRF **Flowers** Jan-April **Populations** **Family** Proteaceae

Distribution

Woolbale Hills (W of Walpole) to E of Mt Many Peaks; Torndirrup NP, Walpole Nornalup National Park, D'Entrecasteaux NP, Two Peoples Bay NR, Gull Rock NP.

Habitat

Outcrop heath, surrounded by karri/marri forest; Mt Manypeaks- low open shrubland; Cheyne Beach- mallee heathland

Agonis marginata, Eutaxia, Stypandra, Acacia myrtifolia; Mt Manypeaks:*Andersonia. sprengelioides, Agonis marginata;* Cheyne Beach: *Agonis marginata, Ag.flexuosa, Gastrolobium bilobum, And ersonia sprengelioides;*

Outcrops & granite boulder;white/grey sand, loamy sand over granite, sandy loam over granite; slope; on and around granite outcrops usually close to the sea.

Threats Identified

Fire	X excessive flats ignition- too frequent.	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X Dieback, Zithiostroma and Armillaria;	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X walk trails		

Other X disease introduction via recreation; signs of senescence pop 26, 6A

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed, seeds germinate

Establishment

Fire enhanced ?

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Rees & Collins 1994: need to maximise biodiversity at sites because of pollinators (honeyeaters); seeder species producing viable seed. Monks-Uneven recruitment, related to major events eg fire; long juvenile period- fire frequency of >20 years required to enable sufficient seed bank accumulation ; granite outcrops may protect from fire; burnt cones released 2x number of seed, burnt trees 10x more likely to have seedlings underneath.

Sources

Briggs and Leigh (1996), Robinson & Coates (1993), Hopper et al (1990), Monks *et al* (1994), Rees and Collins (1994); L. Monks, GJ Keighery, N Gibson pers comm

Boronia tenuis (Lindl.) Benth.

Status P4 **Flowers** **Populations** **Family** Rutaceae

Distribution

Lesmurdie Falls NP; Kalamunda: Dwellingup: Oakley Brook; Helena R valley; Joint Venture. Cooljarloo: N Dandalup Dam; Bickley Brook Reserve.

Habitat

Woodland; low woodland;

Eucalyptus todtiana, Banksia menziesii, B attenuata, Adenanthos cygnorum; E. calophylla, E. laliae, Hakea lissiocarpha, Darwinia citriodora, Xanthosia.

Edge of the scarp on steep slopes.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining	X	**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unstated

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); S. Patrick pers. comm.

Brachysema modesta ms Crisp

Status DRF **Flowers** **Populations** **Family** Leguminosae

Distribution

Treeton Block SF, Jarrahwood.

Habitat

Flat, low plain; laterite, white-grey sandy clay over laterite. or swampy wet sandy clay ; Flat, gully; laterite, ironstone , massive ironstone.

Threats Identified

Fire		**Clearing**	
Logging	X pine harvesting	**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X Roadworks, Pine harvesting(pop2)

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Uknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Crisp (1995); B Keighery, D. Papenfus, GJ Keighery, N Gibson pers. comm.

Brachysema papilio Crisp

Status DRF **Flowers** Sept-Oct **Populations** **Family** Leguminosae

Distribution

SF: Abba Block.

Habitat

Shrubland.

Flat, low plain; ironstone; sand and peat.; red sandy clay with emergent rock, laterite.

Threats Identified

Fire	X prescribed burns	**Clearing**	
Logging		**Firebreaks**	X
Mining	X	**Feral animals**	X rabbits
Disease	X dieback upslope	**Insects**	
Agriculture	X grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks; nutrients from paddocks, weeds

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Restricted habitat, most of which is now cleared.

Sources

Briggs and Leigh (1996), Crisp (1995), Papenfus (1995), Gibson *et al* (1994) ; D. Papenfus, B. Keighery, GJ Keighery, N Gibson pers. comm.

Caladenia arrecta ms Hopper and A.P. Brown

Status P4 **Flowers** Aug-Oct **Populations** **Family** Orchidaceae

Distribution

Esperance to Bindoon, 4 disjunct localities.

Habitat

Esperance; under low dense shrubs; western pops open wandoo woodland, coastal Banksia & Allocasuarina woodland and dense Jarrah forest. H&B Northern for: low open scrub below woodland.

Northern Forest: *Eucalyptus wandoo*

Esperance- moist areas. Northern Forest: high in landscape in rocky lateritic loam;

Threats Identified

Fire X timing of prescribed burns

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman and Brown (1992), Kelly *et al* (1990); SD Hopper pers comm

Caladenia bryceana subsp bryceana ms Hopper and AP Brown

Status DRF **Flowers** Aug-Oct **Populations** **Family** Orchidaceae

Distribution

Jerramungup- Boyup Brook: Wild Horse Swamp NR, Toompup NR, Stirling Range National Park, private, reserve

Habitat

Wild Horse Swamp *Acacia accuminata* thicket < 5m with emergent *Eucalyptus rudis* over *X preissii* and herbs and open low woodland A over scrub. Toompup NR- open woodland over low sedges and grasses.

Wild Horse Swamp: *Eucalyptus occidentalis, Caladenia flava, Chamaescilla. Eucalyptus rudis;* Toompup: *Yate,* over *A. accuminata, E occidentalis, Allocasuarina heugellii, Calytrix.* SRNP:*Eucalyptus wandoo woodland.*

Lake edge; yellow sand; sandy soils; sandy clay or loam, adjacent to water courses.

Threats Identified

Fire	X prescribed burns	**Clearing**	X pop 4 , pop 1f.
Logging		**Firebreaks**	X
Mining		**Feral animals**	X rabbit & fox
Disease		**Insects**	
Agriculture	X grazing pop 4 sheep sometimes let into	**Weeds**	X avena fatua; pop
Urbanisation		**Wildflower harvesting**	
Recreation	X tourist pressure- trampling in Nat Pk		

Other X pop 2 show signs stress in other spp, kangaroo grazing

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Not stated

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

control weeds, investigate relocation, liaisewith landholders

Notes

Sources

Holland *et al* (1997), Briggs and Leigh (1996), Hoffman & Brown (1992), Hopper *et al* (1990); SD Hopper pers. comm.

Caladenia busselliana ms Hopper & AP Brown

Status DRF **Flowers** Sept-Oct **Populations** 4 **Family** Orchidaceae

Distribution

10 km range S of Busselton, Marybrook, Carbunup reserve, Quindalup siding.

Habitat

Ironstone community: Forest over low heath D (Quindalup); Low forest A adjoins low scrub A over low heath C.

Eucalyptus calophylla, Xanthorrhoea spp, Mesomelaena tetragona, Acacia divergens; Eucalyptus calophylla, E. marginata, Agonis flexuosa, Kunzea ericifolia, Mel.aleuca thymoides.

Low plain; grey sand, winter wet swamp.

Threats Identified

Fire	X timing, prescribed burning.	**Clearing**	
Logging	X craftwood, firewood	**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing	**Weeds**	X grassy
Urbanisation	X	**Wildflower harvesting**	
Recreation	X		

Other X rubbish dumped on site, craftwood, firewood collection; roadworks, rail works, accidental destruction

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Urgent liaison with local Volunteer Fire Brigade to prevent prescribed burning at inappropriate time; burn in autumn.

Notes

200 plants seen 1990 after recent burn, only 30 in 1991.

Sources

Papenfus et al (1997), Briggs and Leigh (1996), Hoffman and Brown (1992); D. Papenfus, GJ Keighery, N Gibson pers. comm.

Caladenia caesarea subsp. maritima ms Hopper & AP Brown

Status DRF **Flowers** Aug- Sept **Populations** **Family** Orchidaceae

Distribution

Dunsborough: Eagle Bay, Meelup & Pt Picquet, confined to coastal granite with a NE aspect.

Habitat

Heath; open dwarf scrub over low heath.

Eucalyptus calophylla (stunted), *Daviesia horrida,*

Hilltop, ridge, flat; granite boulder; loamy sand and clayey sand between boulders, sandy clay; grew in soil in cracks in granite.

Threats Identified

Fire	X prescribed burns, timing	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	X rabbit grazing
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X walking, rock climbing		
Other			

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

No evidence that flowering is enhanced by fire

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Propagation, translocation, preserve pops, most wild pops pristine; land acquisition- all pops on shire land; protect from possible grazing, accidental destruction, frequent fire, weeds; rehabilitate verge pops.

Notes

Sources

Briggs and Leigh (1996), Hoffman & Brown (1992); GJ Keighery, N Gibson pers comm

Caladenia christineae ms Hopper & AP Brown

Status DRF **Flowers** Sept-Oct **Populations** **Family** Orchidaceae

Distribution

Manjimup- Mt Barker. Bridgetown. edge of Lake Muir. Nunijup Lake (Shire of Boyup Brook) SF, NR. private. SF.

Habitat

Open woodland (Muir Hwy); open woodland or open jarrah/marri forest; pop 5 open shrubland; pop 7 low forest B over heath B over low sedge; pop 2 heath, overstorey burnt.

Melaleuca cuticularis; Eucalyptus rudis, E. marginata E. calophylla; Kunzea ericifolia, M. preissiana, Astartea fascicularis.

Winter wet edge of lake (L Muir); valley, gully, drainage line on fluviatile gravel in sandy loam (Muir Hwy); pop 5 valley swamp gully, loamy sand, moist; grey sand. on margins of winter wet flats

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	X pigs, rabbits
Disease	X in disease risk area	**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks Muir Hwy pop 4 pop 5 , pop 7, pop 9 ; some kangaroo tracks pop y7; pop 1 road building debris stacked to be burnt in clearing; heavy undergrowth pop 5

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman and Brown (1992), SD Hopper pers. comm.

Caladenia dorrienii Hopper & AP Brown

Status DRF **Flowers** Sept-Oct **Populations** 5 pops **Family** Orchidaceae

Distribution

Frankland to Brookton. Boyup Brook. Perup. Dale; townsite reserve, water res Katanning, Keninup SF. Manjimup. SF , Jarrahdale.

Habitat

Low forest A over low heath C; open forest woodland; open jarrah-wandoo woodland over low scattered shrubs.

Eucalyptus wandoo, Acacia pulchella, Hakea lissiocarpha, Acacia nervosa, Synaphea sp, Thomasia foliosa., Xanthorrhoea, E. rudis, E. calophylla, Hypocalymma, Drosera.

Laterite, gravel; gravelly clay; valley gull, drainage line, fluviatile gravel, sand clay brown yellow; rich brown gritty clay loam on gradual slope with W aspect; p3- damp black loam wide flat floor of broad valley.

Threats Identified

Fire	X Timing of burn, prescribed burns	**Clearing**	X p1
Logging		**Firebreaks**	X p6
Mining		**Feral animals**	
Disease		**Insects**	X p2
Agriculture	X grazing	**Weeds**	X pop 5, p1
Urbanisation		**Wildflower harvesting**	
Recreation	X pop 5		

Other X on verge of gravel pit; roadworks road realignment 7c

Response to Disturbance

Response to fire

Killed by fire/timing; flowering stimulated by summer fire

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman & Brown (1992), Hopper *et al* (1990)

Hibbertia montana Steudel

Status P4 **Flowers** Sept- Nov. **Populations** 7 **Family** Dilleniaceae

Distribution

Mt Bakewell, York ; Boyagin rock NR; Wyalgima Hill; Wongamine NR , Mokine NR , Clackline NR.

Habitat

Woodland over heath B over low heath C.

Powderbark wandoo (*Eucalyptus accedens)*over *Hypocalymma angustifolia, Melaleuca scabra* over *Comesperma scoparia, Petrophile ericifolia, Dampiera lindleyi* .

Steep hillside, brown loam

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation X?

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Patrick (1984); GJ Keighery, N. Gibson, S. Patrick pers. comm.

Caladenia excelsa ms Hopper & AP Brown

Status DRF **Flowers** Sept-Oct **Populations** 13 **Family** Orchidaceae

Distribution

Leeuwin-Naturaliste NP, road verge, private property.

Habitat

Open forest over either scrubland or heathland; woodland over open heathland,

Eucalyptus calophylla, Agonis flexuosa, Banksia attenuata, Allocasuarina. fraseriana.

Flat;sand; deep sand

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X pop 3, pop 8
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X heavily infested
Urbanisation		**Wildflower harvesting**	X
Recreation	X pop 4, 5, 8, 14		

Other X Roadworks- verges side populations of 1-2 plants pop3, 14

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), SD Hopper pers. comm.

Caladenia harringtoniae ms Hopper & AP Brown

Status DRF **Flowers** Oct-Nov **Populations** 30 **Family** Orchidaceae

Distribution

Albany-Nannup, Mt Clarence; Beedelup NP, Lake Muir; Greenbushes SF block; Pemberton, Manjimup, Frankland.

Habitat

Open *Banksia* and Paperbark; mixed *Eucalyptus calophylla /E marginata* forest B over heath B; open tall forest.

Acacia pulchella, X preisii, Dry andra nivea, Bossiaea linophylla.

Winter wet flats; Mt Clarence: in shallow loamy clay over granite outcrop; margins of creeklines and freshwater lakes. fluviatile gravel clay loam. valley, gully drainage line , rocky outcrop (pop 12).

Threats Identified

Fire	X prescribed burns	**Clearing**	X 25
Logging		**Firebreaks**	
Mining	X 25	**Feral animals**	X wild horses
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X 28, 25		

Other X roadworks pops 30, 29, 28 , 27, 22, 21 , 17, 16, 15, 14, 12,9 , 6, 1, 25; wild horses known to be using water hole at p16

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown

Establishment

? Fire enhanced- flowering stimulated by summer fire

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Robinson & Coates (1995) ; Hoffman & Brown (1992); SD Hopper pers. comm.

Caladenia integra E. Coleman

Status P4 **Flowers** Sept-Oct **Populations** 16 **Family** Orchidaceae

Distribution

Mt Bakewell, York to Tenterden. Widely spread pops; Tutanning NR, Boundary of Tenterden NR, shire res, Gravel Res, Mt Latham NR. One disjunct pop at Kalbarri could be extinct.

Habitat

Allocasuarina woodland.

Shallow soil surrounding granite exposures.

Threats Identified

Fire

Logging

Mining X gravel ?

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Exclude weeds, mineral exploration; control recreational activitied on granite outcrops; do not burn Aug-Nov

Notes

Sources

Kelly *et al* (1990), Hoffman & Brown (1992), Hopper *et al* (1990); SD Hopper pers comm

Caladenia interjacens ms Hopper & AP Brown

Status P4 **Flowers** Oct **Populations** 2 **Family** Orchidaceae

Distribution

Walpole Nornalup NP; locally common. West Cliff Pt, Kulikup, SE of Lake Marginup; Mt Hopkins.

Habitat

Low heath & peppermint woodland.

Consolidated coastal dunes.

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/timing, flowering enhanced by summer burn

Response to soil disturbance

Unknown, possibly killed

Establishment

Fire enhanced.

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman & Brown (1992); SD Hopper pers. comm.

Caladenia x triangularis

Status P4 **Flowers** Aug-Oct **Populations** **Family** Orchidaceae

Distribution

Pingelly, Highbury; Clackline NR, Wickepin, Frankland and Stirling Range NP; Yallingup siding

Habitat

Wandoo

Clay

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Poorly known taxon.

Sources

GJ Keighery, Neil Gibson, pers comm

Caladenia viridescens ms Hopper & AP Brown

Status DRF **Flowers** Sept-Oct **Populations** **Family** Orchidaceae

Distribution

Dunsborough.

Habitat

Woodland over open shrubland.

Eucalyptus calophylla, Agonis flexuosa; E. marginata

Hilltop, slope, flat; sand, loamy sand, gravelly sand; well drained lateritic loam or sand sloping down to winter wet depression.

Threats Identified

Fire	X , especially late autumn, winter, spring;	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X most severe
Urbanisation	X increasing rate in area	**Wildflower harvesting**	
Recreation	X- trampling, picking.		
Other	X roadworks, dumping of rubbish		

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

1 population, few plants, has been artificially pollinated.

Sources

Papenfus *et al* (1997), Briggs and Leigh (1996), Hoffman & Brown (1996); D. Papenfus, GJ Keighery, N Gibson pers comm

Caladenia winfieldii ms Hopper & AP Brown

Status DRF **Flowers** Oct-Nov **Populations** **Family** Orchidaceae

Distribution

Strachan: ENE Pemberton on Strachan Rd in Murtin Forest Block. Narrow strip 10-40m S of creek in low flat drainage line.

Habitat

Melaleuca and*Banksia*

Winter wet depression.

Threats Identified

Fire	X inappropriate regime, season, prescribed	**Clearing**	
Logging	X changes to hydrology	**Firebreaks**	
Mining		**Feral animals**	X pigs-digging
Disease	X dieback present, removes overstorey	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X Kangaroos grazing

Response to Disturbance

Response to fire

Killed by fire/timing, needs res

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Unknown

Remedial actions

Essential: control feral pigs, extend fencing, defer further timber extraction, implement disease control, preserve genetic diversity.

Notes

Little known of biology, or of why restricted; requires research into pollination biology, seed production, seed germination; population genetics, response to fire. Grows through skirts of *X preissii*; or closely associated shrubs; flowering likely to be stimulated by summer fire. Hand pollinated plants 1996 produced healthy seed capsules, indicating there is no internal mechanism limiting seed set.

Sources

Holland *et al* (1997), Briggs and Leigh (1996), Hoffman & Brown (1992).

Calothamnus graniticus subsp graniticus

Status P4 **Flowers** May-June **Populations** **Family** Myrtaceae

Distribution

C Naturaliste: Meelup, Eagle Bay, Sugarloaf Rock.

Habitat

Dominant species in granite outcrop vegetation;

Granite outcrops on coast.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation X tracks through some populations

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Hawkeswood (1984); GJ Keighery, Neil Gibson, S Patrick pers comm

Calothamnus graniticus subsp leptophyllus

Status P4 **Flowers** Jun-Aug **Populations** 12 **Family** Myrtaceae

Distribution

Marrinup SF; South Dandalup; Oakley Dam.

Habitat

Marri/wandoo canopy; Eucalypt plantation over low open scrub layer; disturbed revegetated areas- ALCOA sites

Red brown lateritic gravel.

Threats Identified

Fire	X fires on annual or v short frequency	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X risk of fire
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Killed, seeds germinate

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Muir Consulting(1995); GJ Keighery, N. Gibson S. Patrick pers. comm.

Calothamnus pachystachyus Benth.

Status P4 **Flowers** Sept-Oct. **Populations** 7 **Family** Myrtaceae

Distribution

Mogumber/Bindoon: Moora: Seven Mile Well NR, Koodjee NR; Mogumber; Gillingarra, railway res, verge, NR.

Habitat

Low woodland A over dense heath A ; sandplain heathland.

Eucalyptus wandoo and *Allocasuarina heu gelianaover Gastrolobium spinosum, Trymalium, Acacia saligna, Hakea undulata* and low sedges.

Laterite, dry brown loam; sand or sand over laterite.

Threats Identified

Fire X p6, p1,

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks X p5

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), S. Patrick pers. comm.

Calothamnus rupestris Schauer

Status P4 **Flowers** Aug-Oct **Populations** 5 **Family** Myrtaceae

Distribution

St Ronans NR; Boyagin NR; Barrington Quarry; Jarrahdale SF, Canning Da, Catchment area Ashendon Rd.

Habitat

Heath or semi woodland.

Calothamnus spp, Grevillea spp, Hakea, Darwinia.

Slope, loam over granite; gravel near creek bed; around granite outcrops.

Threats Identified

Fire	X	**Clearing**	
Logging		**Firebreaks**	
Mining	X bauxite	**Feral animals**	X rabbits
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation	X	**Wildflower harvesting**	
Recreation	X Canning Dam		
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hawkeswood, Keighery & Alford ; S. Patrick pers. comm.

Chamelaucium erythrochlorum

Status P4 **Flowers** Nov-Jan **Populations** 8 **Family** Myrtaceae

Distribution

Whicher Ra: Sabina R verge shire, shire reserve & gravel reserve; Whicher Block SF; SF: Treeton Block , adjoins private property.

Habitat

Dense forest SP; low forest A over heath B.

Eucalyptus calophylla, Hakea lissiocarpha, Xanthorrhoea/Kingia, Brachysema praemorsum.

On flatslat, sand & clay

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X works on powerlines

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); GJ Keighery, N. Gibson S. Patrick pers. comm.

Chamelaucium sp Gin Gin

Status DRF **Flowers** Oct-Nov **Populations** 4 **Family** Myrtaceae

Distribution

Gin Gin and Muchea, on private property; verges on W side of Darling Scarp, mid slopes; sited immediate above Chandala Swamp Reserve;

Habitat

Very open shrub mallee over open scrub; low woodland B over dwarf scrub C.

Jacksonia sternbergiana, Eucalyptus todtiana, Patersonia rudis, X anthorrhoea preissii; Nuytsia, Banksiaattenuata, Allocasuarina humilis.

yellow grey sand over yellow sand; winter wet depression on white sand; lateritic heath slopes on breakaway

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks, powerline maintenance

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Seeds germinate, effect on mature plant unknown

Establishment

Disturbance opportunist

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Seed germinated in firebreaks and nearby cleared ground but did not penetrate thick scrub nearby, considerable seed drop. Needs open habitat free of competing spp eg *Adenanthos cygnorum* & *Kunzea ericifolia*.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); B. Keighery, D. Papenfus, S. Patrick, G Stack, pers. comm.

Chamelaucium roycei Marchant & Keighery

Status DRF **Flowers** Oct-Dec **Populations** **Family** Myrtaceae

Distribution

Whicher Ra, Ruabon Nature Reserve.

Habitat

Heath A over low heath C; low open woodland A over low heath C; heath B.

Calothamnus sp Whicher, *Kunzea, Hakea; Eucalyptus calophylla; Kunzea micrantha*

Flat; ironstone; clayey sand, sandy loam,

Threats Identified

Fire	X too frequent	**Clearing**	X streamline
Logging		**Firebreaks**	
Mining	X sand	**Feral animals**	X rabbit grazing
Disease		**Insects**	
Agriculture	X grazing	**Weeds**	X grasses
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X roadworks, railway removal

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Not stated

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery *et al* (1996), Gibson *et al* (1994); B. Keighery; D. Papenfus, S. Patrick. GJ Keighery, N Gibson pers. comm.

Conostylis pauciflora subsp pauciflora

Status P4 **Flowers** Aug-Oct **Populations** 2 **Family** Haemodoraceae

Distribution

Yalgorup NP, Mandurah; Tim's Thicket.

Habitat

Jarrah, Marri, Banksia,
sandy soils.

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Killed by fire/reseeds
Response to soil disturbance
Unknown, possibly killed
Establishment

Susceptibility to Phytophthora
Presumed not susceptible

Remedial actions

Notes

Sources
Briggs and Leigh (1996); S. Patrick pers. comm.

Corybas limpidus D Jones

Status DRF **Flowers** Aug Sept-Oct **Populations** 4 **Family** Orchidaceae

Distribution

Esperance to Wilson Inlet; Ledge Pt, Mandalay Beach; Gull Rock areas. Hamersley inlet in Fitgerald River NP and adjacent shire recreation reserve.

Habitat

Always in deep litter, either associated with *Melaleuca lanceolata*; or under low wind-pruned heath: or deep litter with *Adenanthos sericeus*. Woodland *Eucalyptus & Melaleuca*. Coastal heath.

Melaleuca lanceolata; Adenanthos sericeus; Mel nesophila Eucalyptus platypus, Caladenia graminifolia.

Deep sand adjacent to coastal inlets; open ocean face of coastal dunes; lee of first dune

Threats Identified

Fire	X prescribed burn; wild.	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X informal camping area & 4WD track		
Other	X adjacent to track; road maintenance (not high)		

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

After fire at Ledge Pt pop, no litter and Corybas not seen

Sources

Briggs and Leigh (1996), Robinson & Coates (1995), Hoffman & Brown (1992); SD Hopper pers. comm.

Cyanicula ixioides subsp ixioides

Status P4 **Flowers** Sept **Populations** **Family** Orchidaceae

Distribution

Badgingarra - Wagin; York, Bindoon.

Habitat

Jarrah forest, wandoo woodland.

Eucalyptus marginata, E. wandoo.

Heavy lateritic soils.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Fire enhanced, flowering stimulated after summer fire.

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Hoffman & Brown (1992).

Darwinia acerosa Fitzg.

Status DRF **Flowers** Sept-Nov **Populations** 4 **Family** Myrtaceae

Distribution

Mogumber- Wannamal.

Habitat

Thicket over Low Heath C.

Allocasuarina humilis, Hakea trifurcata;

Granite outcrops; sand, sand over granite, red loam over granite.

Threats Identified

Fire	X inappropriate regime, prescribed burning	**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	X grazing
Disease		**Insects**	
Agriculture	X grazing; r2	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other	X roadworks		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Disturbance opportunist

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman & Brown (1992), Hopper *et al* (1990), Kelly *et al* (1990); D. Papenfus; S. Patrick, GJ Keighery, N Gibson pers. comm.

Darwinia apiculata NG Marchant

Status DRF **Flowers** October **Populations** 4 **Family** Myrtaceae

Distribution

Scott River (?) Kalamunda hospital, Water Res; Lesmurdie.

Habitat

open jarrah-marri woodland; open woodland and heath on laterite; woodland over heath.

Eucalyptus calophylla, Eucalyptus wandoo, Eucalyptus marginata ; Allocasuarina fraseriana over patches of *Dryandra sessilis, X preissii, Marri, wandoo, Pultenaea ericifolia, X preissii,*

Gravelly soil over continuous laterite.

Threats Identified

Fire X exclusion level 3

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation X level 3

Clearing

Firebreaks X level 3

Feral animals

Insects

Weeds

Wildflower harvesting

Other X pop size level 1; roadworks level 3; mining nil.

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed, seeds germinate

Establishment

Not stated

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery and Robinson (1992), Kelly *et al* (1990), Hopper *et al* (1990).

Darwinia ferricola ms NG Marchant & Keighery

Status DRF **Flowers** Dec-Jan **Populations** **Family** Myrtaceae

Distribution

Endemic to Scott Plains

Habitat

Heath A or B; Dwarf Scrub D to Dense Heath A ; heath scrublands of Melaleuca/Calothamnus

Adenanthos detmoldii, Actinodium cunninghamii, Restio ustulatus, Aotis carinata, Eutaxia sp, Anarthria scabra, Actinodium cunninghamii, sedges with occasional Mel. preissiana; or Viminaria juncea, Acacia myrtifolia,

Large outcrop of spongolite iron ore on Scott River plains: Low plain, flat, seasonal wetland brownish loamy sand and grey sand on red clay over on ironstone; plain with low sandy rises.

Threats Identified

Fire	X prescribed burns	**Clearing**	
Logging		**Firebreaks**	
Mining	X sand	**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing, clearing, cultivation	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X Roadworks, cattle trampling, water draw down associated with sand mining

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery and Robinson (1992), Leigh *et al* (yr) Rye and Hopper (yr); GJ Keighery, N Gibson pers. comm.

Darwinia sp Williamson (GJ Keighery

Status DRF **Flowers** Oct, Dec **Populations** 1 **Family** Myrtaceae

Distribution

Williamson, below Whicher Range; Abba Forest block.

Habitat

Scrub, dwarf scrub C, open tall sedges.

Hakea aff varia, Regelia ciliata, Dryandra nivea ssp uliginosa, Restio spp.

Southern ironstone: flat, sheet ironstone, grey sand.

Threats Identified

Fire	Xprescribed burns.	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X occurs in area "riddled" with dieback,	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Fire enhanced, possibly seed germination.

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Exclude from any burns.

Notes

Burnt 1992, population starting to flower 3yr past burn.

Sources

Briggs and Leigh (1996), Gibson *et al* (1994); D. Papenfus, B. Keighery , L. Monks, GJ Keighery, N Gibson pers. comm.

Darwinia thymoides subsp St Ronans

Status P4 **Flowers** Oct-Nov **Populations** 1 **Family** Myrtaceae

Distribution

St Ronans NR

Habitat

Low dense heath, low wandoo woodland,

erticordia fimbrilepis

Hilltop, sand over laterite.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Juvenile probably killed.

Response to soil disturbance

Establishment

May be a dsturbance opportunist - most plants along firebreak.

Susceptibility to Phytophthora

Presumed susceptible.

Remedial actions

Notes

Sources

Briggs and Leigh (1996); GJ Keighery pers.comm.

Daviesia microphylla Benth.

Status P4 **Flowers** Jul-Aug **Populations** 41 **Family** Leguminosae

Distribution

Darling Range W of Beverley on road verges and surrounding veg; Wandoo Conservaion Park; road reserves, gravel reserve, nature reserves.

Habitat

Open wandoo - marri woodland over low open heath.

wandoo, marri, *Acacia heugeliana, Hakea prostrata, Hypocalymma angustifolium,*

White-grey loamy sand or lateritic gravel ; sandy loam.

Threats Identified

Fire	X fire exclusion r1- inappropriate regime	**Clearing**	
Logging		**Firebreaks**	
Mining	X exploration, gravel extraction	**Feral animals**	
Disease	X Phtophthora cinnamomi hygiene r3	**Insects**	
Agriculture	X 36 (1989)	**Weeds**	X 37
Urbanisation		**Wildflower harvesting**	
Recreation	X r1		

Other X shire road works Wallaby Hills NR

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Germination enhanced, colonises disturbed sites on graded road verges.

Establishment

Disturbance opportunist; Colonises disturbed sites on graded road verges

Susceptibility to Phytophthora

Unknown

Remedial actions

Plan and supervise logging and mining exploration to ensure pops not disturbed.

Notes

Sources

Briggs and Leigh (1996), Crisp MD (1985); S. Patrick pers. comm.

Drakea confluens ms Hopper & AP Brown

Status DRF **Flowers** Oct- Nov **Populations** **Family** Orchidaceae

Distribution

Boyup Brook; L Chinocup in NR; Boyup Brook, private land; Stirling Range National Park; Collie, private land; Haddleton NR, Ngartiminny.

Habitat

Openings in jarrah-*Banksia* woodland; *Eucalyptus* woodland over low heath C; Woodland over woodland A, with patches of thicket.

Eucalyptus marginata, Banksia attenuata over *Melaleuca sp, Petrophile linearis, Calytrix sp; Eucalyptus leptophylla; Jarrah, Banksia attenuata, Kunzea ericifolia, Eremaea pauciflora.*

Deep sand; sand over clay saline on lake edge; gravelly sand.

Threats Identified

Fire	X prescribed burning	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X pop 4 grazed with stock	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X horses grazing freely		

Other X possibly powerlines maintenance; pop 4- population in a kangaroo camp (on private land) southern end of sandy flay used as winter apiary site

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Robinson & Coates(1994).

Drosera fimbriata DeBuhr

Status DRF **Flowers** Oct **Populations** 5 **Family** Droseraceae

Distribution

Albany-C Riche, William Bay, roadsides.

Habitat

Sandy patches in *Eucalyptus staeri* and *Banksia attenuata* over heath; moss over granite and heath in sand; open dwarf scrub D.

Andersonia caerulea, Platysace pendula.

Deep white sand; or moss over granite.

Threats Identified

Fire		**Clearing**	X - Hassell NP road
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X Hypochaeris,
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks; weed control -slashing. plans by shire to build access Rd to park and Lights Beach from E boundary in William Bay NP

Response to Disturbance

Response to fire

Unknown, probably killed.

Response to soil disturbance

unknown, possibly killed.

Establishment

Disturbance opportunist ?

Susceptibility to Phytophthora

Presumed not susceptible.

Remedial actions

Notes

Numbers greatest in open disturbed areas; fire may also provide more space for establishment of seedlings, summer dormant.

Sources

Briggs and Leigh (1996), Robinson & Coates; Hopper *et al* (1990), Pate and Dixon (1982)

Dryandra mimica AS George

Status DRF **Flowers** Dec-Jan **Populations** 3 **Family** Proteaceae

Distribution

Mundaring, Whicher Range.

Habitat

Low woodland A over Low Heath D with emergents or low heath C; Banksia woodland over closed shrubland.

B. attenuata, B menziesii, Eucalyptus calophylla, Xylomelum occidentale; at Mogumber, E, todtiana, Jacksonia sternbergiana.

Slope; white-grey sand; sand over laterite, Dandaragan plateau.

Threats Identified

Fire	X prescribed burning	**Clearing**	X
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing, trampling of seedlings	**Weeds**	X
Urbanisation	X at Wattle Grove ; semi-rural subdivisions	**Wildflower harvesting**	
Recreation	X		

Other X Roadworks, rubbish dumping, roadworks for mine site

Response to Disturbance

Response to fire

Resprouter/reseeder.

Response to soil disturbance

Unknown, possibly killed

Establishment

Fire enhanced, seed shed.

Susceptibility to Phytophthora

Susceptible

Remedial actions

Notes

Low fruit set, some seed germinating in follicles.

Sources

Briggs and Leigh (1996); D. Papenfus, GJ Keighery, N Gibson S. Patrick pers. comm.

Dryandra nivea subsp. uliginosa ms AS George

Status DRF **Flowers** Aug-Sept **Populations** **Family** Proteaceae

Distribution

Whicher Range, Scott River, Tutunup; Governor Broome Rd.

Habitat

Heath A over low heath C; open heath mixed sedgeland; Ironstone vegetation;open/ closed shrubland; open woodland over sedgeland; Jarrah/Marri woodland; coastal heathland; Dwarf Scrub C over tall sedges.

Melaleuca uncinata, Kunzea sp, Hakea marginata.

Flat; Ironstone; red-brown clayey sand ; winter wet flats, clay over laterite in thick scrub.

Threats Identified

Fire	X prescribed burning, burning of any form	**Clearing**	
Logging		**Firebreaks**	X
Mining	X located on lease at Beenup mine site	**Feral animals**	
Disease	X dieback	**Insects**	X fruits
Agriculture	X cattle grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X Roadworks; Native animal grazing heavy

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Not stated

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), George (1996), Keighery *et al* (1996), Gibson *et al* (1994); D Papenfus, B Keighery pers comm

Dryandra serra R.Br.

Status P4 **Flowers** Sept **Populations** **Family** Proteaceae

Distribution

Disturbed areas Redmond SF (Walpole) to Mt Manypeaks; South Sister NR; Hay SF;Mt Lindesay; Kordabup; Thames SF; Mt Hallowel cons/rec reserve, Hillbrook NR

Habitat

Woodland over thicket; jarrah and marri woodland; Kordabup- jarrah woodland to junction with karri

Hovea elliptica, Persoonia longifolia, Grevillea puchella; Eucalyptus maginata, Banksia grandis; Hakea linearis,

Laterite concretionary gravel, slope; Mitchell RD: sand or gravelly sand over laterite. Hay- shallow pockets of sand over laterite.

Threats Identified

Fire	X prescribed burning Mt Hallowel	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X Phtophthora cinnamomi and some	**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X Mitchell ; 4wd tracks in Hunwick pop		
Other	X roadworks, firewood collection- spreading disease		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

killed, seeds germinate

Establishment

Disturbance opportunist/ enhanced

Susceptibility to Phytophthora

Susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996)

Eucalyptus aspersa Brooker & Hopper

Status P4 **Flowers** - **Populations** 36 **Family** Myrtaceae

Distribution

From near Boyup Brook and Kojonup N through Darling range to Brookton hwy W of Westdale: Mt Saddleback; Katanning; Serpentine; Crossman; Kelmscott, Wearne SF; Boddington Gold Mine; StockyardSF; Lane Poole Res; Wandering SF; Wandoo Conservation Park ; Dodds SF; Mokine NR; Narrogin, gravel reserve; pvt prop.

Habitat

Open jarrah/marri woodland; heath pockets with *E aspersa* surrounded by mixed jarrah/marri/wandoo woodland. Dodds block- cleared paddock. in dry swamp in Jarrah/Marri forest with dwarf casuarina.; Proteaceous heath in

X preisii, Daviesia decurrens, Hakea lissiocarpha

Upper & lower slopes, laterite, fluviatile gravel, sand loam clay, or loamy clay with gravel; skeletal red lateritic loam over gabbro on rocky hill crest (Mt saddleback); yellow brown sandy gravel over cemented laterite;

Threats Identified

Fire	X prescribed burns p6, 5, 7, 27, 25, 21, 22	**Clearing**	X p27
Logging		**Firebreaks**	
Mining	X p5 , 11	**Feral animals**	
Disease	X p4 dieback affected area	**Insects**	
Agriculture	X p29 , p27	**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X p6, 5, 7		

Other X roadworks p31, 28

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown, possibly killed

Establishment

Not stated

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996); SD Hopper pers. comm.

Eucalyptus calcicola Brooker

Status P4 **Flowers** May-June **Populations** **Family** Myrtaceae

Distribution

Leeuwin-Naturaliste NP: Hooley Rd, N of Boranup beach; C Freycinet to C Hamelin.

Habitat

Eucalyptus calcicola shrub mallee over heath A ; emergent above shrubs.

Hakea, Spyridium.

Slope, red brown sand ; coastal limestone dunes; westerly aspect of massive calcareous coastal dunes frequently with outcropping limestone

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other
Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Resprouter/reseeder

Response to soil disturbance
Unknown

Establishment
Unknown

Susceptibility to Phytophthora
Unknown, possibly susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996); SD Hopper, GJ Keighery, N. Gibson pers. comm.

Eucalyptus exilis Brooker

Status P4 **Flowers** Dec-Apr **Populations** 18 **Family** Myrtaceae

Distribution

Dale verge; Mt Leseuer NP; Coorow paddock, road verge; Brookton, shire res; Vacant Crown Land near Boyagin Rock NR; Boyagin Rock NR; Wandering; Wandoo Conservation Park.

Habitat

Woodland or open shrub mallee over heath

Eucalyptus accedens , Dryandra sp, Petrophile & Isopogon sp; Mt Leseuer: *E todtiana;*

Ridge top, just above breakaway; brown gravelly loam over laterite; mt les grey sand over laterite,

Threats Identified

Fire	X prescribed burning	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing- Greenhead-Coroow Rd	**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Unknown

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Rye (1981); SD Hopper pers. comm.

Eucalyptus latens

Status P4 **Flowers** Mar - June **Populations** 23, **Family** Myrtaceae

Distribution

North Bannister, Boyagin NR; Wearne SF, Wandering SF; Highbury SF; Talbot SF; Hopkins NR; Boyagin NR; Timber Res; road verges Narrogin, Katanning (Wickepin) Harrismith; Hillman Townsite res; Sorenson NR; Boddington (edge of mine boundary.

Habitat

Jarrah forest; open woodland

E marginata, E wandoo; X preissii, Dryandra lindleyana, Calothamnus Allocasuarina humilis, And.ersonia nvolucrata.

Yellow brown gravelly over laterite; light brown sandy gravel over laterite;

Threats Identified

Fire

Logging

Mining X Boddington Gold Mine boundary

Disease

Agriculture

Urbanisation

Recreation

Other X roadworks 12, 13

Clearing

Firebreaks

Feral animals X rabbits Hillman

Insects

Weeds X bridal creeper

Wildflower harvesting

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* 1990; SD Hopper pers. comm.

Eucalyptus phylacis K Rechinger.

Status DRF **Flowers** Feb-Mar **Populations** **Family** Myrtaceae

Distribution

W of Busselton-Meelup Castle Rock.

Habitat

Ecotone between heath and marri forest. Open low woodland A over open low scrub A

Jarrah, marri, *X preissii, Allocasuarina humilis, Dryandra nivea, Hakea lissiocarpha, Calothamnus*

Rich brown loam and outcropping granite on lateritic hillside.

Threats Identified

Fire	X shire burning regime	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X dieback, canker.	**Insects**	X borers- was to be
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X roadworks & on edge of carpark.

Response to Disturbance

Response to fire

Resprouter; coppices

Response to soil disturbance

unknown

Establishment

Unknown

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

What were thought of as 19 separate ramets now proven to be all part of same clone; distance between ramets suggests plant of great age 6370 yrs; sets almost no seed, so need to look after in situ. This plant is the largest and possibly oldest Eucalypt ever recorded.

Sources

Jezierski et al (1997), Kershaw et al (1997), Briggs and Leigh (1996); SD Hopper pers. comm.

Eucalyptus rudis subsp cratyantha

Status P4 **Flowers** - **Populations** 5? **Family** Myrtaceae

Distribution

Mandurah & Pinjarrah S and SW to C Naturaliste. Collie , near Wyvern Mine.

Habitat

Woodland ; coastal and subcoastal

B attenuata, B ilicifolia; Caves Rd: grasses & tall sedges in nearby paddock.

Deep white sands, seasonally wet.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing- not fenced off from cattle and	**Weeds**	X grass competition
Urbanisation	X nb low density low impact tourist	**Wildflower harvesting**	
Recreation			

Other X roadworks

Response to Disturbance

Response to fire

Resprouter, not a mallee

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Brooker & Hopper (1993); SD Hopper pers. comm.

Eucalyptus sp West Cape Howe

Status P4 **Flowers** Feb **Populations** 2 or 3 **Family** Myrtaceae

Distribution

West Cape Howe NP.

Habitat

Mallee scattered clumps over heath;

Eucalyptus angulosa, E missilis ms *Acacia littorea, Dryandra sessilis, Loxocarya flexuosa, Rhagodia baccata. In* deep sand with same spp and *Melaleuca diosmifolia*

On high ridgeline, sand over limestone, sand among limestone outcrops; or deep sand on ridge above limestone cliffs.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Wardell-Johnson *et al* (1995); SD Hopper pers.comm.

Frankenia glomerata

Status X **Flowers** **Populations** **Family**

Distribution

Presumed X

Habitat

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Although listedon the DRF list, this species is regarded as extinct by experts in the field.

Sources

D. Papenfus, GJ Keighery, N. Gibson pers. comm.

Franklandia triaristata

Status P4 **Flowers** Aug-Oct **Populations** **Family** Proteaceae

Distribution

Bunbury to Ruabon NR; foothills of Whicher Ra. SE capel , Yoganup Rd
Camp Gully, Argyle block; Maryvale, Jarrahwood, Boyanup, Capel, Tutunup , Mileyannup.

Habitat

Yoganup Rd- growing among pines next to plantation.

Sands of foothills; flat, sand brown grey.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other	X roadworks		

Response to Disturbance

Response to fire
Killed by fire/reseeds

Response to soil disturbance
Killed

Establishment

Susceptibility to Phytophthora
Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Kieghery *et al* (1996), Rye and Hopper (1981); GJ Keighery, N. Gibson pers. comm.

Gastrolobium glabratum ms Crisp

Status P4 **Flowers** Aug, Sept **Populations** **Family** Leguminosae

Distribution

wWof Kojonup, Bridgetown, Manjimup, Williams, Willowdale, reserve 4556 on Collie-Williams Rd

Habitat

Open forests, woodland

Eucalyptusmarginata, E calophylla, E wandoo.

Hilltop; saline sandy loam.

Threats Identified

Fire X prescribed burning

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

S. Patrick pers. comm.

Grevillea cirsiifolia Meisn.

Status P4 **Flowers** Sept-Dec. **Populations** 36 **Family** Proteaceae

Distribution

E of Jarrahdale through Wheatbelt to Denmark, Walpole. Bannister SF; Denbarker SF; Lupton SF; Wandering Block SF, Flint SF, Mooradung NR; Gibbs Block Jarrahdale.

Habitat

Jarrahdale: *Allocasuarina. humilis* scrub over low heath; Denmark- dense low heath D-C

Dryandra armata, Calothamnus, Synaphea, Lepidosperma, Banksia sphaerocephala; with *Sphenotoma dracophylloides* at Walpole; At Denmark- *Acacia tripycna, Darwinian vestita, Hibbertia macrophylla, Cryptandra*

Jarrahdale: shallow yellow-brown sandy loam on lateritic ridge-top plateaux. Denmark: granite outcrop; Collie-laterite.

Threats Identified

Fire	X exclusion r3; prescribed burning	**Clearing**	
Logging	X	**Firebreaks**	X r3, p15
Mining	X r2	**Feral animals**	
Disease	X dieback hygiene r1	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X r1, p8 cannabis cultivation one forest		
Other	X railway maintenance p15		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Protect from fire, exclude mineral exploration and logging.

Notes

Regenerates after autumn burn, seedlings suffer from summer dry.

Sources

Briggs and Leigh (1996), Olde & Marriott (1995), Hopper (1990); S. Patrick pers. comm.

Grevillea drummondii

Status P4 **Flowers** July- Dec **Populations** 23 **Family** Proteaceae

Distribution

Darling range, Bindoon-Bolgart; Hardey , pvt; Pemberton, Shannon Rock; Glen Forest, pvt; Cambray Forest Block; Sussex Block, p 8 in and around gravel pit; Grimwade Rd, Kerr Block; Moora, Gravel reserve 27995, Yandin Res 38571, road verge; Blackwood, St John & Greenbushes Block; Walpole; Nannup, Boronia Block;

Habitat

Greenbushes- Jarrah Marri woodland ; Yandan hill- low heath; in north- under E wandoo woodland, rarely low heath.

Eucalyptus lane-poolei, many epacrids, *Acacia aff myrtifolia; gb- Eucalyptus alo, Xanthorrhoea, Castrolobium spinosum;*

Gravelly brown loam on lateritic rises; heavy lateritic loam; Greenbushes- shallow dry sandy soil over massive granite; Yandan Hill- on edge of breakaway, in north on massive laterite or lat loam soils.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed, seeds germinate

Establishment

Disturbance opportunist comes up on disturbed road verges and gravel

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Olde and Marriott (1995).

Grevillea elongata PM Olde & NR Marriott

Status DRF **Flowers** Oct **Populations** 3 **Family** Proteaceae

Distribution

Ruabon; Tutunup; private property, road verges Wonnerup Rd, Ludlow-Hitherglen Rd.

Habitat

Low shrubland, highly modified; heath A and dense heath B; Low woodland A over heath B; Heath B.

Eucalyptus rudis, Eucalyptus calophylla; Calothamnus aff quadrifidus, Dryandra squarrosa, Grevillea diversifolia. Pericalymma elliptica.

Flat; ironstone; sheet; sand loam; red brown gravelly clay.

Threats Identified

Fire	X any type; verge burns on private property	**Clearing**	
Logging		**Firebreaks**	
Mining	X sand mining	**Feral animals**	
Disease	X	**Insects**	
Agriculture	X cultivation on private property	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X roadworks; in road verge

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Gibson *et al* (1994), Olde and Marriott (199?); B. Keighery, D. Papenfus, GJ Keighery, N Gibson pers. comm.

Grevillea flexuosa (Lindl.) Meisn.

Status DRF **Flowers** May **Populations** 3, **Family** Proteaceae

Distribution

Gidgegannup NP, recreation; Monadnocks Conservation Park; Berry NR ; Wundowie.

Habitat

Exposed granitic rock vegetation and low heath.

Granitic sand among granite rocks in exposed platform

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X		
Other			

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Olde and Marriott (199?), Leigh *and Briggs (1992)*; S. Patrick pers comm

Grevillea mccutcheonii ms Keighery & Cranfield

Status DRF **Flowers** May-Dec, peak **Populations** 1 **Family** Proteaceae

Distribution

Tutunup; roadsides, private property.

Habitat

Degraded road verge; tall shrubland over low shrubs and sedges- highly degraded.

Dryandra aff nivea, Loxocarya sp, Juncus pallidus, Viminaria juncea, Regelia ciliata, Pericalymma elliptica. Melaleuca, annual weeds.

Shallow red clay associated with ironstone at base of Whicher Ra. in low lying location, wet in winter ; on perched wetlands= Abba Wet Ironstone Flats.

Threats Identified

Fire	X inappropriate regime.	**Clearing**	X majority of
Logging		**Firebreaks**	
Mining		**Feral animals**	X rabbits
Disease	X Dieback unknown, but location of pop	**Insects**	
Agriculture	X grazing- cattle removed 1994 & pop	**Weeds**	X most threatening,
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X Kangaroo grazing, roadworks, failure of communication; movement of stock along rd.

Response to Disturbance

Response to fire

Germination enhanced by smoke

Response to soil disturbance

Unknown

Establishment

possible Disturbance opportunist

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

X essential- weed control, fire protection, minimise risk of PC infection, monitor. Desirable- buffers and rehab habitat, fence and regenerate private property.

Notes

Included in smoke trials at Kings Park & Botanic Gardens
interim recovery plan 1996-1999.

Sources

Jezierski *et al* (1997), Briggs and Leigh (1996), Papenfus *et al* (1995) Brown (1995); B. Keighery, D. Papenfus,GJ Keighery, N Gibson pers. comm.

Grevillea pimelioides Fitzg.

Status P4 **Flowers** winter- spring **Populations** **Family** Proteaceae

Distribution

Helena & Canning Rivers ; small pops over limited area; Mt Helena,

Habitat

Jarrah /marri forests Darling Range semi shaded;

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Killed by fire/reseeds
Response to soil disturbance
Unknown, possibly killed
Establishment

Susceptibility to Phytophthora
Presumed susceptible

Remedial actions

Notes

Sources
Briggs and Leigh (1996), Olde and Marriott (1995); S. Patrick pers. comm.

Grevillea ripicola AS George

Status P4 **Flowers** Aut-Spring **Populations** **Family** Proteaceae

Distribution

Scattered pops Collie, Collie River, possibly Kirup, Greenbushes, Northcliffe; Muirillup.

Habitat

Open jarrah forest; dense thicket of *Viminaria*, but doesn't like to be overtopped.

Viminaria juncea, Agonis parviceps, Agonis flexuosa, Eucalyptus patens.

Gravelly loam or clay loam on river banks, creekline, occ in close proximity to granite outcrops; Greenbushes in shallow dry sandy soil over massive & outcropping granite.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X O&M
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed, seeds germinate, seedlings appear in large number on worked road verges etc.

Establishment

Possible disturbance opportunist, seed germinate readily on disturbed sites

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Olde and Marriott (1995)

Grevillea saccata Benth.

Status P4 **Flowers** June-August **Populations** 24 **Family** Proteaceae

Distribution

Badgingarra- Gin Gin, Greenough <Dandaragan> Bookendarra Ck.

Habitat

Very open mixed *Eucalyptus* woodland over *Banksia* scrub and low heath; open heath occasionally in low swamp.

Eucalyptus. calophylla, Eucalyptus.marginata Eucalyptus. lane-poolei, Banksia menziesii- B attenuata

Lateritic upland, yellow-brown sandy and lateritic soils; sandy gravel, sand or clay;

Threats Identified

Fire	X exclusion r2	**Clearing**	
Logging		**Firebreaks**	X r3
Mining	X r3	**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Resprouter/ Equivocal- stated as both seeder and sprouter.

Response to soil disturbance

Killed, seeds germinate, establishes on disturbed roadsides

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Exclude populations from prescribed burning; autumn burn only at min. 12 yr intervals, do not grade roadside plants.

Notes

Sources

Olde and Marriott (1995), Kelly *et al* (1990), Hopper *et al* (1990); S. Patrick pers comm

Hemiandra rutilans O. Sarge.

Status DRF **Flowers** **Populations** 9 pops **Family** Lamiaceae

Distribution

Dowerin, York, Toodyay; currently presumed extinct.

Habitat

Sand heath

Sand

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown

Establishment

On disturbed sites

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Last plant died 1994, only known plant was on farmland.

Sources

Briggs and Leigh (1996), Hopper et al (1990); D. Papenfus, S. Patrick pers. comm.

Hemigenia platyphylla (Bartl.) Benth

Status P4 **Flowers** Sept-Oct **Populations** **Family** Lamiaceae

Distribution

Mt Bakewell; Stirling Range NP; Wandering SF; Dryandra SF; Wyalgima Hill.

Habitat

Very open woodland.

Eucalyptus wandoo, Eucalyptus calophylla.

Shallow black loam over granite.

Threats Identified

Fire X non specific

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); S. Patrick pers comm.

Hibbertia miniata C. Gardner

Status P4 **Flowers** Jul-Oct **Populations** **Family** Dilleniaceae

Distribution

Wannamal; Hay Flat Rd.

Habitat

Open low woodland A over scrub over dwarf scrub D

Eucalyptuswandoo, Eucalyptus calophylla, Dryandrasessilis, Adenanthos cygnorum.

Laterite, boulder, loam gravel brown.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture X grazing

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Rye & Hopper (1981).

Hibbertia silvestris Diels

Status P4 **Flowers** Aug-Mar **Populations** **Family** Dilleniaceae

Distribution

Lane Poole NP, Shannon NP; Darling Scarp and Range from Waroona Dam to near Collie , and south to between Nannup and Pemberton (SF).

Habitat

Mixed jarrah woodland; forest, dense heath B

Eucalyptus marginata, Eucalyptus calophylla, Eucalyptus diversicolor , yarri, over understorey *Bossiaea eriocarpa,* Ridge; loamy sand,

Threats Identified

Fire	X prescribed	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Unknown, probably killed

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996)

Hypocalymma sp Scott River (AS George 11773)

Status P4 **Flowers** Nov-Dec **Populations** **Family** Myrtaceae

Distribution

Scott R. Northcliffe to Blackwood R. Frankland NP; Chesapeake Rd; Broke Inlet, Windy Harbour; Scott R.

Habitat

Low woodland, heath over sedges, sedgeland, shrubland.

Melaleuca

Winter wet sites; sand over clay, sand over ironstone.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Survey a priority.

Sources

Keighery & Robinson (1992)

Kennedia glabrata (Benth.) Lindl.

Status DRF **Flowers** Sep-Nov **Populations** 7 **Family** Papilionaceae

Distribution

Northcliffe; E of Esperance: Mt Chudalup; Muirillup Rock, Cons Pk; Walpole; D'Entrecasteaux NP; William Bay NP.

Habitat

Granite outcrop.

Mosses and herbs

Shallow pockets of soil on granite outcrops.

Threats Identified

Fire	X frequency	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X Muirillup Rock & Mt Chudalup		
Other	X roadworks (Nelson Rd pop)		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Fire enhanced, seed germ

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Ensure frequency of fire such that several seasons of seed production may occur between fire; research population ecology.

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); S Patrick pers. comm.

Kennedia macrophylla (Meisn.) Benth.

Status DRF **Flowers** Sept-Nov **Populations** **Family** Papilionaceae

Distribution

Augusta , near sea.

Habitat

Coastal scrub land or Karri Forest; low heath C invaded by dense low grass adjacent to dense heath A.

Among granite outcrops, black humus rich sands.

Threats Identified

Fire X prescribed burning

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other X weed eradication process

Clearing

Firebreaks

Feral animals

Insects

Weeds X post fire invasion,

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Poduces large amounts of seed

Sources

Kennedia macrophylla (Meisn.) Benth.

Status DRF **Flowers** Sept-Nov **Populations** **Family** Papilionaceae

Distribution

Augusta , near sea.

Habitat

Coastal scrub land or Karri Forest; low heath C invaded by dense low grass adjacent to dense heath A.

Among granite outcrops, black humus rich sands.

Threats Identified

Fire X prescribed burning

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other X weed eradication process

Clearing

Firebreaks

Feral animals

Insects

Weeds X post fire invasion.

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Poduces large amounts of seed

Sources

Lambertia echinata sub occidentalis

Status DRF **Flowers** Oct-Dec **Populations** **Family** Proteaceae

Distribution

Busselton, Whicher range, same sites as *Darwinia sp Williamson & Petrophile latericola.*

Habitat

Threats Identified

Fire		**Clearing**	X
Logging		**Firebreaks**	
Mining	X sand mining - road widening	**Feral animals**	
Disease	X dieback	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks- sand mining company expansion.

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Sources

Curry (1992), N Gibson, GJ Keighery pers. comm.

Lasiopetalum bracteatum (Endl.) Benth

Status P4 **Flowers** Oct-Nov **Populations** **Family** Sterculiaceae

Distribution

Kalamunda NP; res 21569; Helena Valley ; Canning R water catchment.

Habitat

Open scrub to 3m over low scrub to 1m in open low woodland.

Grevillea obtusfolia, Eucalyptus calophylla, Hakea undulata, Grevillea bipinnatifida, Hibbertia hypericoides.

Granite outcrops near streams.

Threats Identified

Fire	X frequency- Lesmurdie NP, Helena Valley	**Clearing**
Logging		**Firebreaks**
Mining		**Feral animals**
Disease		**Insects**
Agriculture		**Weeds**
Urbanisation		**Wildflower harvesting**
Recreation	X Helena Valley picnic spot, Lesmurdie	
Other		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); C. Wilkins, Sue Patrick pers. comm.

Lambertia orbifolia CA Gardner

Status DRF **Flowers** Dec- Mar **Populations** **Family** Proteaceae

Distribution

Scott River, Narrikup.

Habitat

Low open woodland; Scott- dense scrub or heath

Narrikup- *Eucalyptus staerii;* Scott R- *Agonis scrub, or L orbifolia is dominant near sea.*

Narrikup- brown-grey sandy loam over laterite; Scott- shallow sandy loam over ironstone.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X Dieback; canker at Narrkup	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Seeds with high level of germination. Small quantity of seed in litter- could be eaten by granivores. Hot fire autumn 1991- significant recovery at Adelaide springs, low level of inter fire recruitment.

Sources

Obbens & Coates (1997), Briggs and Leigh (1996), Keighery & Robinson (1992); Hopper *et al* (1990); D Papenfus, GJ Keighery pers. comm.

Lambertia rariflora subsp rariflora Meisner

Status P4 **Flowers** Jan-Mar **Populations** **Family** Proteaceae

Distribution

Margaret R: SF; Whicher, Jarrahwood. most populations in SF; land subject to mining claims.

Habitat

Open or closed forest

Eucalyptus megacarpa, Eucalyptus calophylla dominated

Lateritic or clayey soils near intermittent streams

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996); GJ Keighery pers. comm.

Laxmannia jamesii Keighery

Status DRF **Flowers** May-July **Populations** 18 **Family** Liliaceae

Distribution

Busselton, Walpole, Albany, some pops on roadside; Gull Rock, Two Peoples Bay.

Habitat

Open woodland Tc; Jarrah/Sheoak woodland; heath; sedgeland. low closed heath over sedges.

Eucalyptus calophylla, Agonis parviceps, Darwinia oedenoides, Stylidium repens.

Winter wet sandy soils, sparse leaf litter. on laterite. sandy peaty soils seasonally damp.

Threats Identified

Fire	X wildfire, prescribed burns	**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X grasses
Urbanisation		**Wildflower harvesting**	
Recreation	X on side of track		
Other	X roadworks		

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Robinson & Coates(), Hopper *et al* (1990), Keighery (1987); B. Keighery; GJ Keighery, N Gibson pers. comm.

Lechenaultia laricina Lindl.

Status DRF **Flowers** Oct-Dec **Populations** **Family** Goodeniaceae

Distribution

Spencers Brook- Sw of Beverley.

Habitat

Open *Eucalyptus* woodland over open scrub

Eucalyptus. marginata, Eucalyptus calophylla, Eucalyptus wandoo

Sand or gravelly loam.

Threats Identified

Fire	X frequent burning; fire exclusion r1	**Clearing**	
Logging		**Firebreaks**	X r3
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X r1		

Other X roadworks; pop size r3

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Not or occasionally killed, seeds germinate, favours disturbed sites.

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Do not disturb roadside plants; fence pops subject to grazing; control weed species. autumn burn at minimum 12 ys, pending research on fire and life history.

Notes

Pioneering species shaded out by dense vegetation; well established in cultivation. Kelly et al 1990.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990) Kelly *et al* (1990); D. Papenfus, S. Patrick pers. comm.

Lechenaultia pulvinaris CA Gardner

Status DRF **Flowers** Oct- Jan **Populations** 15 pops **Family** Goodeniaceae

Distribution

SW of Beverley; Dumbleyung; on firebreaks.

Habitat

Bare patches below *Allocasuarina. acuaria* thicket in open scrub below *Banksia menziesii- Eucalyptus calophylla* open woodland.

Firebreaks; or bare ground

Threats Identified

Fire	X exclusion r1	**Clearing**	
Logging		**Firebreaks**	X r3
Mining	X r1	**Feral animals**	X rabbits grazing &
Disease		**Insects**	
Agriculture	X spray drift and fertiliser	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X r2		
Other			

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Germination enhanced, growing on firebreaks, road verges and open patches;

Establishment

Possible disturbance opportunist

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

*appears to experience cycles of decline in the wild. Large pops at Wickepin-Dumbleyung following fire in 1980 but have declined to a few individuals.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990), Patrick (1983),S. Patrick, D. Papenfus pers. comm. ;

Leptomeria dielsiana Pilger

Status X **Flowers** **Populations** **Family**

Distribution

Scott River; presumed extinct- not collected since the 1950's

Habitat

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Presumed extinct.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); B. Lepschi, GJ Keighery pers. comm.

Melaleuca basicephala

Status P4 **Flowers** Dec-Feb **Populations** 5 plus **Family** Myrtaceae

Distribution

Scott Plains to Blackwood R; along south coast at Scott R D'Entrecasteaux NP, Gingilup NR, SF & RR. at Brockman Hwy, Windy Harbour, Mt Pingerup, Inlet Rd .

Habitat

Low heath over sedges, or low open shrubland

Sand over clay, winter wet flats; low lying swamps.

Threats Identified

Fire

Logging

Mining X Gingilup swamp pop.

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery & Robinson (1992); N. Gibson pers. comm.

Meziella trifida (Nees) Schindler

Status DRF **Flowers** Oct-Nov **Populations** **Family** Haloragaceae

Distribution

Scott Plains, Nillup Plain (Chester block last remaining uncleared habitat).

Habitat

Low heath over sedges, on river bank.

Pericalymma, Restio, Leptocarpus

Open depressions on sandy clay saturated flats. Plants grow sometimes in shallow water, otherwise on sand which is still wet and has covering of organic ooze. hallow deep pools or on saturated soils.

Threats Identified

Fire	X fuel reduction burn timing of burn.	**Clearing**	
Logging	X	**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X		
Other			

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Robinson & Coates (); B Keighery, D Papenfus, GJ Keighery N Gibson pers. comm.

Microtis globula R. Bates

Status DRF **Flowers** Dec-Jan **Populations** 6 **Family** Orchidaceae

Distribution

William By, Bakers Junction, Oyster Harbour, Parry Inlet. Walpole to Albany. Walpole Nornalup National Park.

Habitat

Microtis spp,

Peaty soils of swamps; winter wet peaty swamps.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation	X?	**Wildflower harvesting**	
Recreation			

Other X locn in ephemeral swamps makes vulnerable to accidental destruction

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown

Establishment

Fire dependent- flowering

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Robinson & Coates(), Hoffman & Brown (1992), Hopper et al (1990); S Patrick pers. comm.

Microtis pulchella R.Br.

Status P4 **Flowers** Nov-Dec **Populations** 5 **Family** Orchidaceae

Distribution

Albany - Augusta; D'Entrecasteaux NP, Owingup Swamp NR, West Cape Howe NP; Donnelly R; L William, West Cape Howe NP.

Habitat

Wet peaty swamp; peat bogs.

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other
Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Killed by fire/timing

Response to soil disturbance
Unknown, possibly killed

Establishment
Fire enhanced- stimulated flowering

Susceptibility to Phytophthora
Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hoffman & Brown (1992); S. Patrick pers. comm.

Parsonsia diaphanophleba F. Muell.

Status P4 **Flowers** Jan-Feb, May **Populations** 3 **Family** Apocynaceae

Distribution

Banks of Murray and Serpentine Rivers

Habitat

Lane Poole: M.c. S. S.A. SB. SC. d. Moderately dense.

E rudis, Mel raphiophylla, Casuarina obesa.; E rudis, Eucalyptus calophylla, Eucalyptus marginata Acacia pulchella, Pteridium esculentum, Trymalium spathulatum, Macrozamia reidli, Clematis pubescens

River banks

Threats Identified

Fire	X prescribed burning, summer wildfire	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X riverside		
Other			

Response to Disturbance

Response to fire

Unknown, probably killed

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Surveyed 1995: 14 years previously was burnt on S side late spring, after 14 yrs still >50% less plants on burnt site than on unburnt, some areas no plants at all.

Sources

Briggs and Leigh (1996), Gibson *et al* (1994) ; N. Gibson, B Keighery pers. comm.

Petrophile latericola ms

Status DRF **Flowers** Oct-Nov **Populations** 2, 1 has **Family** Proteaceae

Distribution

Swan Coastal Plain SE of Busselton; Westrail reserve, State forest Tutunup;.

Habitat

Tall or low heath; Banksia woodland;

B grandis, X preissii, Xylomelum, Adenanthos, Andersonia aff latiflora, Hakea aff varia; Dryandra squarrosa (tall heath).

Winter wet flats; red sandy clay over ironstone.

Threats Identified

Fire	X inappropriate regimes	**Clearing**	
Logging		**Firebreaks**	
Mining	X Westrail pop on mining lease 1992	**Feral animals**	
Disease	X dieback suspected on second site	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X one pop on side of firebreak

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed, seeds germinate

Establishment

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Continued decline in occurrence. one pop destroyed by fire, dieback suspected on second site. no mat indivs on site with legal protection, successfully proposed in cultivation;
1 population may be recently extinct from burning, but too soon to tell yet.

Sources

Briggs and Leigh (1996), Gibson *et al* (1994), Keighery & Robinson (1992); B. Keighery, N. Gibson, D Papenfus pers. comm.

Pimelea rara Rye

Status DRF **Flowers** Jan-Feb **Populations** **Family** Thymeliaceae

Distribution

Mundaring; Karnet Block, Victoria Block; between Mundaring Weir and Perth observatory.

Habitat

Mc; M.c. SB. SC. c-d.; scattered low shrubs under open jarrah forest

Jarrah , *Corymbia; Banksia grandis, Dryandra sessilis,D nivea, Hakea prostrata, X preissii, Loxocarya flexuosa. Adenanthos barbigera Banksia grandis, Xanthorrhoea, Macrozamia, Pimelea floribunda, Patersonia occidentalis.*

Slope, concretionary gravel, Slope; yellow sand, clay gravel.

Threats Identified

Fire	X prescribed burns	**Clearing**	X proposed bridle
Logging	X on internal roads; pine silviculture	**Firebreaks**	X
Mining	X ALCOA bauxite mine in future	**Feral animals**	
Disease	X spot infections in pop 4	**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X road grading, pine silviculture, gravel pit rehab, firewood collection

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Grafted materials grown at Kings Park & Botanic Garden
Successful germinations at Kings Park & Botanic Garden 6/6/90
Recent fire appears to have been beneficial,further research needed.

Sources

Briggs and Leigh (1996); S. Patrick pers. comm.

Pultenaea pauciflora M. Scott

Status DRF **Flowers** Oct-Nov **Populations** 22 **Family** Leguminosae

Distribution

Lupton Conservation Park; near narrogin.

Habitat

Eucalyptus calophylla and *Eucalyptus astringens* woodland; Lupton M.LA.ci. S.SA.SB.SC.SD.c.i.r. Open Jarrah / Marri. : M.LA.i.r, S.SA.SB.SC. c-d, M.LA.c. S.SA.SB.SC.SD.c.i. Powderbark Wandoo/Jarrah/Marri woodland

Lupton: *Eucalyptus accedens, Eucalyptus marginata, Eucalyptus calophylla, Dryandra sessilis, D. nivea, D. armata, Alloc. humils, Acacia puchella;* Narrogin: *Hakea prostrata, Banksia grandis, Bossaiea sp, Hibbertia*

mid slope; white clayey sand; rocky gravelly upslope; Laterite, sheet and boulder rocks, sand with gravel. Breakaway, associated with plateau; sand with gravel and clay.

Threats Identified

Fire	X prescribed burns	**Clearing**	X
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease	X ?	**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X main pops on Narrogin golf course		
Other			

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Little known of biological requirements, produce few viable seed no recruitment-could be dependent on disturbance.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); D. Papenfus pers. comm.

Pultenaea skinneri F. Muell.

Status P4 **Flowers** July-Jan **Populations** 69 **Family** Leguminosae

Distribution

Collie Basin, Eaton, North Boyanup, Nannup, Pemberton.

Habitat

Woodland; paddock with Paperbark & scrub; low forest A

Banksia attenuata, B ilicifolium; Eucalyptus calophylla,

Deep white sands, seasonally wet.

Threats Identified

Fire		**Clearing**
Logging		**Firebreaks**
Mining	X mineral exploration?	**Feral animals**
Disease		**Insects**
Agriculture	X grazing N Boyanup	**Weeds**
Urbanisation		**Wildflower harvesting**
Recreation		
Other		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Rye (1981).

Reedia spathacea F. Muell.

Status P4 **Flowers** **Populations** **Family** Cyperaceae

Distribution

D'Entrecasteaux NP, Walpole Nornalup National Park; Walpole; Highly disjunct distribution.

Habitat

Swamp, thick reeds

In very wet areas, swamps

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	X
Recreation			
Other			

Response to Disturbance

Response to fire

Unknown, probably killed

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

clonal species

Sources

GJ Keighery, N. Gibson, S. Patrick, pers. comm.

Restio chaunocoleus F. Muell.

Status DRF **Flowers** Aug-Sept **Populations** 3 **Family** Restionaceae

Distribution

Toodyay: subdivision; Badgingarra NP, Moora, mining lease, Cooljarloo; Private property Bolgart.

Habitat

Heath b, ecotone where drainage line vegetation changes to woodland; or Thicket over heath B over open low sedges.

Mel aleuca scabra, Kunzea recurva, X anthorrhoea preissii. Adenanthos cygnorum, Jacksonia floribunda, Banksia menziesii.

Loam peat, saline, winter wet; pop 3 yellow sand

Threats Identified

Fire		**Clearing**	X lots on Majestic
Logging		**Firebreaks**	X pop 3, 2
Mining	X	**Feral animals**	
Disease	X potential dieback- pop1	**Insects**	
Agriculture		**Weeds**	X
Urbanisation	X	**Wildflower harvesting**	
Recreation			

Other X Telstra cabling operations in road reserve; road upgrading associated with subdivision; kangaroo grazing pop 1 b; roadworks pop 3, 2

Response to Disturbance

Response to fire

Unknown, probably killed

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* (1990); S. Patrick pers comm

Rinzia crassifolia Turcz.

Status P4 **Flowers** Aug-Sept **Populations** 5 **Family** Myrtaceae

Distribution

Darling Ra N to Watheroo and E to Cunderdine Mundaring, Katanning, Tarin Rock; road verges.

Habitat

Tarin rock : *Verticordia sp* and *Beaufortia sp.* Wambyn Rd: open woodland with *Eucalyptus* ; heath with scattered *Allocasuarina.*

Lateritic clay. Tarin Rock: sandy gravel; Wambyn: crest of hill , lateritic gravel.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), S. Patrick, pers. comm.

Rulingia sp Trigwell Bridge R Smith s.n.

Status DRF **Flowers** Sep **Populations** **Family** Sterculiaceae

Distribution

West Arthur

Habitat

Open woodland

Marri, jarrah wandoo; *Banksia. Acacia pulchella, Banksia grandis, Bossiaea ornuta;* ground layer annual weeds (grasses & clovers), most understorey removed;

Slope, outcrop, breakaway; laterite boulder; shallow sandy gravel, grading into loam derived from granite on lower slopes of breakaway

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	X rabbits; fenced
Disease	X not specified	**Insects**	X grazing of mature
Agriculture	X grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X "pruning" by Twenty Eight Parrots- (Australian Ringnecks) wire cages installed

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Kings Park & Botanic Garden to attempt propagation; consider establishing plant on nearby reserves.

Notes

Attempts to germinate at Kings Park & Botanic Garden unsuccessful; Recovery Plan 1996.

Sources

Briggs and Leigh (1996) Stack and Brown (1996); D. Papenfus, C. Wilkins pers. comm.

Sphenotoma drummondii (Benth.) F. Muell.

Status DRF **Flowers** **Populations** 10 **Family** Epacridaceae

Distribution

Mt Frankland NP, Stirling Range National Park, Mt Manypeaks NP; Waychinnicup NR.

Habitat

Open woodland or montane heath.

Andersonia; Kunzea montana, Darwinia leiostyla, Mel bauerifoliam Dryandra armata.

Hilltop, outcrop, ridge; schist; loam. summits and slopes of rocky peaks, shallow soil over granite, schist or quartzite.

Threats Identified

Fire

Logging

Mining

Disease X PC all pops Stirling Range National

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Highly susceptible

Remedial actions

Notes

Needs special protection, many seedlings which germinated postfire on Bluff Knoll now dying from dieback. Population on Mt Frankland relocated October 1997.

Sources

Briggs and Leigh (1996); K. Lemsom, K Brown, L Monks pers. comm.

Spirogardnera rubescens Stauffer

Status DRF **Flowers** Aug-Nov. **Populations** 8 **Family** Santalaceae

Distribution

Moora, Mundaring, Marchagee, Coorow- roadside vegetation in ag land; Alex Morrison NP; Bindoon - Eneabba.

Habitat

Low scrub B; Low open woodland A over Dwarf scrub C; open mallees; or on sand heath.

Acacia wilsonii ; Eucalyptuswandoo, Xanthorrhoea. drummondii: Leucopogon sp, Synapheae sp.

Hilltop; brown loam/laterite/gravel; or on sand lateritic soil;

Threats Identified

Fire	X prescribed burning	**Clearing**	X
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other	X Roadworks		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

No plants seen 2 years after hot summer burn. Kings Park & Botanic Garden seed trials 1989- 10 seed sown in vitro, 2 germinated but no further development , cutting mats as well, none took. Type locality has been cleared.

Sources

Briggs and Leigh (1996), Kelly *et al* (1990), Hopper *et al* (1990); S. Patrick pers. comm.

Spirogardnera rubescens Stauffer

Status DRF **Flowers** Aug-Nov. **Populations** 8 **Family** Santalaceae

Distribution

Moora, Mundaring, Marchagee, Coorow- roadside vegetation in ag land; Alex Morrison NP; Bindoon - Eneabba.

Habitat

Low scrub B; Low open woodland A over Dwarf scrub C; open mallees; or on sand heath.

Acacia wilsonii ; Eucalyptuswandoo, Xanthorrhoea. drummondii: Leucopogon sp, Synapheae sp.

Hilltop; brown loam/laterite/gravel; or on sand lateritic soil;

Threats Identified

Fire	X prescribed burning	**Clearing**	X
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other	X Roadworks		

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

No plants seen 2 years after hot summer burn. Kings Park & Botanic Garden seed trials 1989- 10 seed sown in vitro, 2 germinated but no further development , cutting mats as well, none took. Type locality has been cleared.

Sources

Briggs and Leigh (1996), Kelly *et al* (1990), Hopper *et al* (1990); S. Patrick pers. comm.

Stylidium scabridum Lindl.

Status P4 **Flowers** Sept-Oct **Populations** 42 **Family** Stylidiaceae

Distribution

Moora, Merredin, Wandoo Conservation Park; nature res, gravel pit, road verges; Flynn & Gunapin SF- Wandoo Conservation Park.

Habitat

M.LA. i.r. SB.SC.c. very open, with occasional emergents.

Wandoo/jarrah *with Banksia attenuata, B menziesii, Nuytsia, Allocasuarina humils, Conospermum stoechadis.*

Grey or white sand slope.

Threats Identified

Fire	X prescribed burning	**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	X rabbits- NR pop
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X gravel pit pop trail bikes		
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Pop in Flynn Block burnt 1995, no regeneration from rootstock or seedlings by Dec 1995.

Sources

Briggs and Leigh (1996), Papenfus (1995), Hopper *et al* (1990). S. Patrick pers comm

Tetraria australiensis CB Clarke

Status DRF **Flowers** Nov-Dec **Populations** **Family** Restionacea ?

Distribution

Mundijong, Ruabon NR, Lambkin res Serpentine; private property, serpentine; Waroona; Ambergate; Cannington.

Habitat

Marri & jarrah over 1-1.5m scrub (war): Heath B to low scrub B over dwarf scrub c over herbs and sedges (Lambkin); Jarrah low woodland A over low scrub b over dwarf scrub D over low sedges (Serpentine)

Hakea stenocarpa, Dryandra armata, X preissii over sedges (Waroona); *Pericalymma ellipticum, Adenanthos meisneri, Mesomelaena tetragona (Lambkin); Jarrah, Xanthorrhoea acanthostachys* (Serpentine).

grey sand over clay; gravel sand clay (Serpentine);

Threats Identified

Fire	X wild	**Clearing**	
Logging		**Firebreaks**	
Mining	X ? planned mineral sands exploration	**Feral animals**	
Disease		**Insects**	
Agriculture	X grazing	**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X Lambkin reserve-damaged by laying of Telecom cable, reserve rehab with alien spp and gap allowed weed invasion. one pop on shire gravel reserve., Waroona; expansion of rubbish tip

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown, possibly killed

Establishment

Fire enhanced- flowering

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Perennial sedge, species is rare because of loss of habitat and is abundant within preferred habitat.

Sources

Briggs and Leigh (1996), Gibson *et al* (1994); B. Keighery; GJ Keighery, N Gibson pers. comm.

Thelymitra dedmaniarum R. Rogers

Status DRF **Flowers** Oct-Nov **Populations** 22 **Family** Orchidaceae

Distribution

Gidgegannup, Walyunga NP, Talbot Rd, Mt Talbot; wandoo cons park; private property; Mundaring- rec reserve.

Habitat

Open Low woodland A over low heath D over low sedges, or over open dwarf scrub C or D.

Eucalyptus wandoo/ accedens, Hakea lissiocarpha, Allocasuarina humils.

Hilltop or ridge; granite, laterite & quartz; sand, loam & gravel, red-brown. granitic slope

Threats Identified

Fire	X prescribed burning; spring burns	**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	X pigs.
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	X
Recreation	X 1 is popular picnic site		

Other X roadworks- verge suffering seasonal deterioration and weed invasion; weed invasion after fire

Response to Disturbance

Response to fire

Killed by fire/timing; flowers after summer fire

Response to soil disturbance

Unknown, possibly killed

Establishment

Unknown

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

In cultivation- Kings Park & Botanic Garden.

Sources

Briggs and Leigh (1996), Kershaw *et al* (1996), Hoffman & Brown (1992); S Patrick, SD Hopper pers. comm.

Thelymitra stellata Lindl.

Status DRF **Flowers** Oct-Dec **Populations** 10 pops **Family** Orchidaceae

Distribution

Habitat

Low heath or in shrubs in jarrah forest.

Rocky tops of small hills ; lateritic loam.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown, possibly killed

Establishment

Fire enhanced- flowering

Susceptibility to Phytophthora

Presumed not susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Hopper *et al* (1990), Hoffman & Brown (1992); S Patrick.pers comm.

Thomasia glabripetala SJ Patrick

Status DRF **Flowers** Sept-Oct **Populations** 5 **Family** Sterculiaceae

Distribution

Range of 10 km E of York

Habitat

Scrub layer of E wandoo

Deep yellow sand over gravel

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			

Other X roadworks

Response to Disturbance

Response to fire

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Patrick (1993) ; S Patrick, C. Wilkins pers. comm.

Tripterococcus brachylobus ms WR Barker

Status P4 **Flowers** **Populations** **Family** Stackhousiaceae

Distribution

Scott Plain

Habitat

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other

Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire
Killed by fire/reseeds

Response to soil disturbance
Unknown

Establishment
Disturbance opportunist

Susceptibility to Phytophthora
Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996); N. Gibson, GJ Keighery pers. comm.

Verreauxia verreauxii (Vriese)Carolin

Status P4 **Flowers** Dec-Jan **Populations** 51 **Family** Gooodeniaceae

Distribution

SW of Beverley, Dowerin; 44 pops Wandoo Cons Park, Dobaderry NR (now also Wandoo Conservation Park) SF: Sullivan, Flynn, Gunapin blocks; one pop private property.

Habitat

Banksia woodland ; M.LA.r. SB.SC.SD.c. v low open *Banksia attenuata/menziesii/ grandis* flat.

Allocasuarina humilis, Xanthorrhoea, Mesomelaena tetragona, Petrophile divaricata

Open white sand.

Threats Identified

Fire	X controlled & aerial burns in spring;	**Clearing**	
Logging		**Firebreaks**	X routine grading-
Mining		**Feral animals**	x rabbits grazing &
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Killed by fire/reseeds. resprouter rarely; timing important

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Spring 1994, 17 mature plants before burn, 1 regeneration prolifically from lignotuber, 92 seedlings germinated need to burn in Autumn, morph suggests poll by small bees and hover flies,
a single pop in Flynn block supported good growth after a spring burn- 991, good condition in June 1994; condition deteriorates considerably between winter and summer.

Sources

Briggs and Leigh (1996), Hopper *et al* (1990) S. Patrick pers. comm.

Verticordia fimbrilepis subsp. australis Turcz.

Status DRF **Flowers** Oct-Nov **Populations** 4 **Family** Myrtaceae

Distribution

Willyung; Kent R; Narrogin (2 pops); road verge, Water Catchment Reserve.

Habitat

Low heath; jarrah-marri woodland; low forest B over Dwarf scrub D.

Eucalyptus marginata, Eucalyptus calophylla, Verticordia. plumosa, Allocasuarina. Andersonia sp, Hakea sp, Agonis flexuosa;; Allocasuarina heugelliana, Verticordia. densiflora, Verticordia pennigera; Tall grass over dwarf Brown loam surrounding granite outcrops; yellow-brown clay loam; sand over gravel.

Threats Identified

Fire	X prescribed burning	**Clearing**	
Logging		**Firebreaks**	
Mining	X close to rock pile in quarry	**Feral animals**	
Disease	X low-moderate	**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation	X		

Other X roadworks pop 3 ; close to road- vehicles; pop 1 occurs within Readimix Quarry

Response to Disturbance

Response to fire

Resprouter/reseeder

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Presumed susceptible

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Robinson & Coates (1993), Hopper *et al* (1990).

Verticordia lehmannii Schauer

Status P4 **Flowers** Dec- Feb. **Populations** **Family** Myrtaceae

Distribution

Scott Plains, Busselton to Walpole. Scott NP, Walpole Nornalup National Park; S of Tutunup; Scott R plains; Boggy Lake; Fish NR

Habitat

Heath or sedgeland

Sand over clay, winter wet flats.

Threats Identified

Fire

Logging

Mining

Disease

Agriculture

Urbanisation

Recreation

Other X roadworks.

Clearing

Firebreaks

Feral animals

Insects

Weeds

Wildflower harvesting

Response to Disturbance

Response to fire

Killed by fire/reseeds

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

cryptic spp not readily observed

Sources

Briggs and Leigh (1996), Keighery & Robinson (1992) , GJ Keighery, N. Gibson pers. comm.

Verticordia lindleyi subsp purpurea

Status P4 **Flowers** Nov-Dec **Populations** **Family** Myrtaceae

Distribution

Widespread but scattered: Woodanilling: rail reserve, road verge; Stirling Range NP; Kojonup, road verge; Nyabing. verge; Beaufort R NR; Hillman; Aldersyde; Collie: spoils dump, Muja; Darkan Swamp.

Habitat

Mallee woodland; open woodland of *Eucalyptus wandoo* over low heath C. (*Verticordia)*: Beaufort Bridge- low open scrub B to 1.2m over Dwarf scrub D over low grass (exotics)

V acerosa, Santalum, Melaleuca spp; V acerosa, V serrata, V pennigera, V densiflora, Regelia, Banksia, Petrophile: Beaufort Br Br- Callistemon phoeniceous, V densiflora, regelia cymbifolia, cal quadrifidus, V

Gravelly loam in floodway; river flat, white grey sand over sandstone , gravelly sand over laterite, saline sand over brown loam; Beaufort R Br- low plain, sand over loam.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	X rabbits (hillman)
Disease		**Insects**	
Agriculture		**Weeds**	X veldt grass
Urbanisation		**Wildflower harvesting**	
Recreation			
Other	X roadworks		

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Briggs and Leigh (1996).

Verticordia multiflora subsp multiflora Turcz.

Status P4 **Flowers** **Populations** 9 **Family** Myrtaceae

Distribution

Porongurup NP; Darkin Swamp, Wandoo Cons Pk; West Arthur, verge; Hillman NR; Katanning, verge; Kamballup; Woogenilup; Toolibin; Dragon Rocks NR.

Habitat

Low heath ; casuarina open scrub; open jarrh - marri woodland

V endlicheriana, V habrantha, V pennigera Kunzea recurva, Eucalyptus & Allocasuarina around edge of patch.

Greyish brown sandy loam, sand loam over granite.

Threats Identified

Fire
Logging
Mining
Disease
Agriculture
Urbanisation
Recreation
Other
Clearing
Firebreaks
Feral animals
Insects
Weeds
Wildflower harvesting

Response to Disturbance

Response to fire

Response to soil disturbance

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Briggs and Leigh (1996)

Verticordia plumosa var ananeotes (Desf.) Druce, var AS George

Status DRF **Flowers** Dec **Populations** I **Family** Myrtaceae

Distribution

Ambergate Reserve.

Habitat

Dense shrub layer ; open low woodland over low heath C; Low scrub B to open tall grass.

V densiflora, Grevillea brachystylis, Stirlingia, Nuytsia floribunda, Xanthorrhoea

Wet flats; flat swamp, grey sandy clay.

Threats Identified

Fire	X prescribed burning- frequency	**Clearing**	
Logging		**Firebreaks**	X
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	X
Urbanisation		**Wildflower harvesting**	
Recreation			
Other			

Response to Disturbance

Response to fire

Resprouter

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Keighery *et al* (1996), B Keighery, D Papenfus pers. comm.

Wurmbea calcicola TD Macfarlane

Status DRF **Flowers** May-July. **Populations** 1 **Family** Liliaceae

Distribution

Cape Naturaliste , Leeuwin Natturaliste NP.

Habitat

Open or shaded patches in low shrubland or heath; low shrubland.

Melaleuca heugellii, M acerosa, Spyridium globosum, Beyeria viscosa, Olearia axillaris, Guichenotia ledifolia

Small colonies in brown loam in pockets on coastal limestone cliff.

Threats Identified

Fire		**Clearing**	
Logging		**Firebreaks**	
Mining		**Feral animals**	
Disease		**Insects**	
Agriculture		**Weeds**	
Urbanisation		**Wildflower harvesting**	
Recreation	X		
Other			

Response to Disturbance

Response to fire

Unknown

Response to soil disturbance

Unknown, possibly killed

Establishment

Susceptibility to Phytophthora

Remedial actions

Notes

Sources

Briggs and Leigh (1996), Macfarlane (1993),Hopper *et al* (1990), Pate and Dixon (1982); S. Patrick pers comm.

Wurmbea drummondii Benth

Status P4 **Flowers** May- **Populations** 16 **Family** Liliaceae

Distribution

Three Springs, Moora to Tincurrin; Nature reserves, road verges, private land: Meenar NR, Wongamine NR, Dongolocking NR, Kulyaling NR, rail reserve Pingelly, Poison Gully NR, Mortlock NR, Mt Hardy NR; Duck Pt Reserve; Brookton.

Habitat

York Gum and *Acacia accuminata* woodland ; low woodland of Acacia accuminata;low open scrub.

Eucalyptus.loxophleba, Acacia accuminata

Clay or loamy soils; low wet ; upland ridgetop plateau; sandy clay slope.

Threats Identified

Fire	X timing of fire; exclusion r1	**Clearing**	X Brookton so
Logging		**Firebreaks**	X Poison Gully
Mining		**Feral animals**	X pigs
Disease	X Phtophthora cinnamomi hygiene r1	**Insects**	
Agriculture	X grazing r1, Mortlock NR, Koodjee NR	**Weeds**	X; r3, road verges
Urbanisation		**Wildflower harvesting**	
Recreation	X r1, Duck Pt , Brookton so		

Other X "special rural subdivision" ; soil disturbance, weed slashing, herbicide spraying Brookton so; rubbish dumping; road works and shire stockpiles

Response to Disturbance

Response to fire

Killed by fire/timing

Response to soil disturbance

Unknown

Establishment

Susceptibility to Phytophthora

Unknown

Remedial actions

Control invading weeds; spring-early autumn burn at min 12 years interval.

Notes

Sources

Kelly *et al* (1990); Hopper *et al* (1990), Briggs and Leigh (1996), Pate and Dixon (1982); GJ Keighery, N. Gibson pers. comm.