Wyong Shire Council

Interim Survey Guidelines for Ground Orchids which are Listed on the Threatened Species Conservation Act, 1995 in Wyong Shire

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1.0 INTRODUCTION

Wyong Shire Council is in the process of conducting a Ground Orchid Study. Gunninah Environmental Consultants has been engaged by Council to complete this study. Seasonal surveys were conducted to coincide with the peak flowering times of targeted ground orchid species. This is essential for orchid surveys since most orchids can only be identified when in flower. However, due to the cryptic flowering behaviour of a number of these ground orchid species, only a few additional records of the threatened orchid species were added to the known number of threatened orchid species sites.

A preliminary version of the Ground Orchid Study has indicated that most of the orchid species targeted by the survey programme are likely to be highly cryptic and possess a broad range of habitat preferences. The detection of targeted orchid species is likely to rely to a significant extent on chance due to the relationship which orchid species have with mycorrhiza in the soil. It is emphasised that some orchid species are pollinator specific and this is due to the high degree of specialisation of their floral parts. Habitat for orchids, therefore, will be related, in some cases to insect habitat. Orchids are also known to flower in response to fire and other disturbance events.

Work conducted to date by Wyong Shire Council and Gunninah Environmental Consultants has confirmed that there are many uncertainties conducting orchid surveys and assessments. These guidelines have been developed to assist in the formation of conclusions with regard to "eight part tests". However, they will not negate the need for conducting seasonal surveys and "eight part tests" by applicants.

2.0 GROUND ORCHID SPECIES WHICH ARE LISTED ON THE THREATENED SPECIES CONSERVATION ACT, 1995

Orchid species in general have a patchy and sporadic occurrence across the landscape both temporarily and spatially within areas which constitute potential habitat.

A total of four orchid species which are listed on the *Threatened Species Conservation Act,* 1995 occur within Wyong Shire. These species are:

- Thick Lip Spider Orchid, *Caledonia tesselata*
- Leafless Tongue Orchid, *Cryptostylis hunteriana*
- Rough Doubletail, *Diuris praecox*
- Angus' Onion Orchid, *Microtis angusii*

Some specific information on orchid ecology and some the difficulties associated with conducting orchid surveys ·from Gunninah Environmental Consultants is attached in Appendix I and II. Relevant information on threatened orchid species which are known to occur in Wyong Shire has been included to assist environmental consultants with the task of preparing "eight part tests".

3.0 GUIDELINES FOR CONDUCTING ORCHID SURVEYS

Due to the specific habitat preferences of ground orchids it is possible to identify "good" orchid habitat. Similarly, other habitat can be excluded as likely orchid habitat.

Most orchids are only able to flower in habitats containing open spaces in the understorey, or low understorey vegetation (<30cm) such as low grass, herbs or open heath. Many species flower best after fire, which often reveals them to be far more common than is apparent from unburnt sites. In habitats with a tall dense understorey, orchids may also be found along the edge of tracks.

The potential habitat of many of the orchid species which are listed on *Threatened Species Conservation Act,* 1995 which are known to occur in Wyong Shire is quite broad, *however* it was possible to record some information on the characteristics of known threatened orchid species sites, for example the presence of common orchid species such as *Cryptostyiis subuiata* or *Cryptostyiis erecta* may be a useful indicator that the particular microhabitat conditions in the habitat are still suitable for a suite of orchid species which could include rarer species such as *Cryptostyiis hunteriana.* Information on possible micro-habitat indicators for threatened ground orchid species is contained in Appendix I.

It should be noted that targeted orchid species may not always occur where suitable habitat conditions exist, as successful growth and reproduction of terrestrial orchids is dependent upon the presence of the specific fungal associations in the soil which allow for both seed germination and carbon transfer within the plant. The correct fungi must be available in order to erode to seed coat to allow germination and to penetrate the outer zones of the growing root to allow the transfer of the essential nutrients necessary for the plant's growth. The presence of different fungal association in the soil also appear to *have* a significant influence in determining whether orchids will be present or absent in particular parts of the landscape.

Orchids are pollinated by many different sources, including birds, beetles, moths, flies, ants, termites, bees, wasps and self-pollination. Bees and wasps are considered the most important insect group associated with the pollination of orchids. Many of the small-flowered species of *Caiadenia* (eg. *Caiadenia catenata)* are pollinated by *native* bees in a simple relationship. Certain species of *Theiymitra* are commonly visited by small bees which are attracted by the brightly coloured flowers.

Mimicking another flower in a common means adopted by some species to achieve pollination. Some species of *Diuris* achieve this by mimicking pea flowers in the genera *Daviesia* and *Pultenaea* which produce nectar and are pollinated by small bees and (less commonly) wasps. The shape and colouration of the central parts of the *Diuris* flower strongly mimics the pea flower although no nectar is produced. This mimicry lures the bees to the orchid.

Table 1 Modes of Pollination Used by Ground Orchid Species Targeted by Seasonal *Survey* Programme (Adapted from Gunninah, 1999)

Orchid Species	**Mode of Pollination**
Cryptostylis hunteriana	Sexual deception by wasps (pseudocopulation)
Caledenia tesseiata	Bees and wasps
Microtis angusii	Ants
Diuris praecox	Mimicking pollinators and wasps

A substantial number of *native* orchids produce seeds after self-pollination. *However,* some groups may only resort to self pollination if visits by insects are not successful (eg, *Caolochilus)* whereas others are adapted wholly for self-pollination (eg, *Orthoceras strictum,* some *Thelymitra* spp). As few orchid species are wholly self-pollinating (ie, they may be outcrossing as well) it is difficult to comment on whether these self-pollinating and/or outcrossing orchids will be conserved in small populations. Habitat fragmentation may also be a potential threat to *native* pollinators. Different orchid species are pollinated by different species of wasps/bees/ants and therefore home ranges of pollinators may *vary.* More research needs to be undertaken in this area.

It is proposed to develop an Orchid Conservation Management Plan for Wyong Shire. This plan will seek to introduce land management strategies on lands where known orchid populations occur and other areas which possess high quality orchid microhabitats. It is proposed to develop this plan over the next eighteen months. Due to the difficulties of detecting many threatened orchid species, the future Conservation Management Plan will focus on the conservation of some sites where threatened orchid species have been recorded. A substantial reliance will also be placed on the conservation of a variety of different vegetation types (across the landscape) where high quality orchid microhabitats occur but where actual sightings of threatened ground orchids have not actually been made.

This approach will place a significant reliance on the conservation of a number of large parcels of bushland connected by corridor linkages. This approach will seek to maintain ecological processes operating at a landscape scale, i.e. pollinator dispersal opportunities and habitat for native pollinators.

The following guidelines have been devised to outline Council's requirements for orchid survey programmes:

1 The survey for threatened ground orchid species will only be undertaken by suitably qualified Botanists or persons suitably experienced in orchid taxonomy.

2 Targeted surveys for threatened orchid species should be carried out in the main flowering season of targeted orchid species on sites which possess "good quality" orchid microhabitats and within potential orchid habitats. A summary table for the four threatened ground orchid species is provided in Appendix I which gives details of orchid microhabitats and flowering seasons.

3 All vegetation communities containing potential orchid habitats should be sampled using a "random meander" approach. A vegetation map indicating variation in vegetation, canopy coverage, understorey condition and orchid microhabitat indicators. The meanders must occur within both open and closed habitat. Sides of tracks and areas of disturbance should also be included within the survey results.

4 Pre-planning of threatened ground orchid surveys should occur to target relevant ground orchid species within their respective flowering period where suitable orchid microhabitats are present. Surveys should also be conducted to take advantage of opportunistic disturbance conditions such as post-bushfire conditions, as these events are more likely to induce orchids to flower, and thereby prove or disprove the presence of threatened orchids on the site. Hence post-disturbance event orchid surveys are probably the best time to conduct surveys to gain the highest level of confidence in confirming whether or not threatened ground orchids are present on the site.

5 Where a known threatened orchid recording is known to have been made from a reliable source and recent record in the vicinity of the development site, it is recommended that a detailed seasonal survey programme be conducted to confirm the extent of the population on the site and in adjacent areas.

6 Applicants will also provide an assessment as to the nature and degree of threatening processes operating on the site and the likelihood of controlling and/or managing those threatening processes in the post development landscape.

Where any of the four listed orchid species is found to occur, the site proforma in Appendix III should be completed.

APPENDIX I

Preliminary Results of Ground Orchid Study

Orchid Species on the TSC Act Recorded in the Wyong LGA				
Orchid Name	**Common Name**	**Status**	**Flowerinq Time**	**Known Microhabitats**
Cryptostylis hunteriana	Leafless Tongue Orchid	Sch2 (Vul)	Nov - Feb	Occurs in woodland habitats in association with *Themeda australis* grasslands with other orchid species such as *Cryptostylis subulata* and with *Cryptostylis erecta*. It has also been recorded on the fringes of swampy heath vegetation.
Caladenia tesselata	Thick Lip Spider Orchid	Sch 2 (Vul)	Sept-Oct	Occurs in heathland / open forest in areas with higher light levels and fringes of wetland areas.
Diuris praecox	Rough Doubletail (B Branwhite)	Sch 2 (Vul)	July - early August	Occurs in woodland habitat within close proximity to the coast and on coastal headlands. *Diuris* species mimic species of the Fabaceae: Faboideae family. *Diuris* species do not offer any reward to pollinators and therefore often appear to mimic other flowers nearby. Therefore *Diuris* species often occur in association with members of the Pea family. Large populations are known to occur in coastal headland habitats as well.
Microtis angusii	Tall Onion Orchid	Sch 1 (End) (Taxonomic uncertainty exists concerning whether this species occurs in Wyong Shire)	Sept-Oct	Occurs in open woodland habitats on edges of wetlands.

APPENDIX II

RELEVANT EXTRACTS FROM GUNNINAH ENVIRONMENTAL CONSULTANTS (1999) REPORT IN PROGRESS

3 SOILS of the STUDY AREA

The study area is located within the Central Coast Lowlands of the Gosford-Lake Macquarie 1:100000 map sheet (Murphy 1993). The soil landscapes of the Gosford-Lake Macquarie 1:100000 map sheet have been mapped by the Department of Conservation & Land Management (now the Department of Land & Water Conservation – DLWC), and the area has been divided into seven physiographic regions including the McDonald and Watagan Mountain Ranges, the Awaba and Erina Hills, the Somersby Plateau, the Hawkesbury Valley and the Central Coast Lowlands.

The study area for the ground orchid survey is located within the Central Coast Lowlands physiographic region of the Gosford-Lake Macquarie 1:100000 map sheet. This region is noted by Murphy (1993) as occupying *-the coastal strip east of the Watagan Mountains between Terrigal* and *Munmorah State Recreation Area. This region* consists *of relatively low lying terrain of low* rises *on the Narrabeen group-.* The more extensive Broader Study Area (Figure I) includes the *-alluvial plains* and *dune fields along the coast. A* series *of coastal lakes (Tuggerah, Munmorah* and *Macquane) occupies a large portion of the Lowlands-.*

Much of the study area involves relatively low-lying lands and gently undulating landscapes around Warnervale and Wallarah Creeks. The study area is characterised primarily by erosional and alluvial soil landscapes including the Doyalson and Gorokan erosional landscapes and the Wyong alluvial soil landscape. Swamp soil landscapes are also present particularly the Tacoma soil type in low-lying areas, with disturbed terrain also typical of portions of the study area. In the south of the study area (near Wyong). The residual Woodburys Bridge landscape is present north of the Wyong River (Appendix 2).

The Broader Study Area includes coastal portions of the LGA and the northern and southern parts of the Shire which include a substantial number of additional soil landscapes. The coastal areas include extensive aeolian landscapes. including the Norah Head and Tuggerah landscapes. The northern portion of the Broader Study Area includes areas of the Doyalson soil landscape as well as the Awaba erosion all aridscape. The southern part of the Broader Study Area (to the south of Tuggerah Lake) includes extensive colluvial and alluvial soil landscapes including the Watagan, Erina and Wyong landscapes as well as more elevated and dissected lands in the Woodburys Bridge residual landscape.

4 ORCHID ECOLOGY and CONSERVATION

Many of the rarer species of Australian orchids are already extinct due to loss of habitat.
illegal collection and the inability of the plants to adapt to a changing environment. All
Australian orchids are now protected plants in all states. They are perennial plants. divided
into two major groups:

1. Terrestrial orchids which have tubers (small round fleshy underground parts of the root system) or rhizomes (an elongate fleshy root stock). They are normally found growing in sandy. loam or clay soils or in deep humus of the forest floor. Some genera are found on the trunks of tree-ferns or in the forks of trees and occasionally on mossy rocks.

2. Epiphytic orchids which are generally supported on the trunk and limbs of trees or on moss and humus-covered rocks. These are more abundant in rain-forest with their main occurrence in Australia being confined to the eastern coastal ranges and areas of relatively high rainfall and high humidity (Cady & Rotherham 1970).

The orchid family is classified as the highest evolved form of plant life due to its floral structure and specialised methods of attracting insects for the pollination of its bloom (Cady & Rotherham 1970). Many orchids have an intimate

relationship with their pollinator, in some cases relying on a Single species of insect to perform this function (Johnson et *al* 1998). This high degree of specialisation has resulted in a precarious existence for many orchid species. Due to their diversity, wide distribution, adaptation to many habitats and sensitivity to habitat changes, orchids are an excellent indicator of the health of ecosystems as well as the effectiveness of conservation initiatives and strategies (Backhouse & Jeanes 1995). When an area of Australian bushland suffers disturbance, orchids are often the first plants to decline (Coupar & Van Bockel 1998).

4.1 Natural Hybridisation

Orchids hybridise freely in nature, possibly more freely than any other group of plants. These natural hybrids usually occur between closely related species within a genus. However, hybrids between genera are not unknown. Hybrids are much more common in environments which have been disturbed. Both *Caladenia* and *Diuris* exhibit a range of hybrid forms sometimes in such a bewildering array as to defy logical separation. Botanists speculate that the frequency of hybridisation in orchid species is a reflection of their ability to adapt to changes in their environments (D. Jones 1993). John Riley *(pers comm*) suggests that hybrids are more frequent in disturbed areas because the native pollinator for an orchid species may be replaced by an exotic species of pollinator which does not discriminate between species of orchid thus producing hybrid orchid species.

4.2 Orchid Tubers

Some orchids produce a new tuber annually. If the undergrowth is too thick then an orchid will not emerge that year and will produce a smaller new tuber from which next years shoot will attempt to emerge. Some orchid species may have the potential to survive for up to 30 years below the surface before conditions allow for it to emerge (J. Riley *pers comm*).

4.3 Transplanting

Transplanting does not usually work. To dig up and cultivate native terrestrial orchids is very difficult. John Riley states that in his thirty years of observing orchid populations he has found that an area will only sustain a certain number of orchids in a population in the long term, in good years an orchid population may temporarily expand but numbers will always go back down. From this reasoning J. Riley *(pers comm)* states that if an orchid is not already growing in a particular spot it will never be able to grow in that spot.

4.5 Factors Affecting Orchid Conservation

Over-collection

Decline in orchid numbers can be due to over-collection by both botanists for herbarium specimens and by gardeners for their collections. Many species have been collected to the brink of extinction and beyond (eg, one of Britain's rarest wild flowers the lady's slipper orchid *(Cypripedium calceolus* L) was at one time thought to be extinct despite its habitat changing very little. Its decline was almost entirely due to over-collection (Ramsay & Stewart 1998)). All orchids in NSW are protected on public land and threatened species are protected on both public and private land. However. it is a law difficult to police and safety from poachers is never guaranteed. On occasions the location of some extremely rare species has been kept a secret (Coupar & Van Bockel 1998).

In the Wyong Shire it is not known if any of the species are under threat from collection. J. Riley *(pers comm)* states that native terrestrial orchid cultivation is extremely difficult and is a specialised area with no commercial market. He only knows of a few people in each state who are able to grow terrestrial species of orchid. In Wyong *Diuris alba* has been collected from the shire in small numbers for years (J. Riley *pers comm).*

Pest Fauna Species

Most terrestrial orchids are perennials that persist from season to season as underground tuberoids or tuberous root systems. Some genera such as *Acianthus, Corybas* and *Pterostylis* proliferate by forming several tuberoids from each parent plant. Feral pigs actively seek out the succulent roots and tuberoids of plants and are therefore a major threat to orchid populations (Metcalfe 1995). Rabbits threaten orchids not only by grazing on vegetative parts above the ground but also by digging up the fleshy tubers as well (Coupar & Van Bockel 1998).

Weed competition

Any disturbance to native bushland is usually followed by weed invasion, notably exotic grass species which out-compete many indigenous plants, including orchids (Coupar & Van Bockel 1998). Weeds compete with orchids for light moisture space and nutrients and also tend to encourage introduced slugs and snails. Invading scrub and tree species have caused a decline in orchid numbers not only in Australia but also world wide (Waite & Farrell 1998; Willems & Melser 1998; Sosa & Platas 1997; Warren 1989).

Weeds such as blackberry *(Rubus fruticosus* sp agg) and Scotch Broom *(Cytisus scoparius)* take over areas previously known to contain orchids. It seems that orchids cannot survive under extremely dense canopy cover (Metcalfe 1995).

Habitat Loss and Fragmentation

In their study on the extinction and persistence of rare orchids in Mexico, Sosa &.Platas (1997) found that habitat fragments can be important in maintaining species diversity. When epiphytic species were stranded in small forest fragments, remnant and introduced trees in surrounding pastoral lands helped to maintain orchid diversity as the orchids persisted on both. Clearly logging host trees will pose a threat to populations of epiphytic orchids. In Australia, the protection of rainforest species and the enforcement of stream protection prescriptions will mean that the problem of loss of habitat suitable for epiphytic orchids will be reduced (Metcalfe 1995).

The logging of hardwood communities poses a threat to terrestrial orchids. However, some species of terrestrial orchids will be advantaged in the short term by logging due to increased available of light resulting from the opening of the canopy. A likely result is in an increase the number of ground orchids that flower. However, the long term welfare in such a disturbed habitat would not be possible to predict without detailed study. It is likely that dense regeneration of trees or undershrubs will eventually reduce the light to below the **optimum level for orchids, reducing the flowering and vegetative growth of the surviving** plants (Metcalfe 1995). Extinction rates are influenced by the resilience of a species to clearing and fragmentation, the ability of a species to occupy secondary habitat and the role of habitat fragments in maintaining species diversity (Heywood & Stuart 1992).

Grazing

Cattle sheep and macropods will eat the flowering plants of orchids but unlike damage caused by pigs and rabbits the grazing of flowering plants

does not destroy the plant. The net effect of grazing is to prevent the plant from setting seed for that season which could be a long term problem where the species does not produce several tuberoids each year and where over-grazing occurs (Metcalfe 1995). Over-grazing by macropods and possums is caused by population imbalances attributed to adjoining land settlements.

Damage by trampling is another impact of grazing especially during wet weather or in permanently moist sites. The most severe impact can be along the banks of streams and soaks an important micro-habitat for several species or orchids (Metcalfe 1995).

Ground feeding birds can cause problems digging up whole populations of orchids in their search for food. For example, the number of White-winged Choughs has increased between five and ten-fold over the last thirty years in the Warrandyte State Park, Victoria. This is due to increased settlement resulting in an increase in the area of interface between forest and cleared land (the bird's preferred habitat); the construction of farm dams has made available mud for nest building in dry gullies which were not previously used for breeding and supplementary food from local residents increases carrying capacity of the land in poor seasons. Between 1989 and 1991, 90% of the largest population of the Rosella Spider Orchid *(Caladenia rosella)* was dug up by these birds (Coupar & Van Boekel 1998).

4.4 Management Strategies

Fauna exclusion fences

In Warrandyte State Park, rabbit exclusion fences were installed around areas with a high number of orchid plants or a high diversity of species. Orchid numbers have increased over a three year period following construction of the exclusion fences and each species has responded favourably to the removal of threatening factors. It may be necessary to erect pig-proof fencing to protect areas where populations of rare and endangered species have been located in forests where feral pigs are a problem.

If a colony of significant plants was known to exist on farm land, it would be advisable to exclude stock by fencing to prevent damage from grazing and trampling.

Weed Control

When sites become overgrown with weed species orchid numbers have been known to decline rapidly. As a management tool the hand cleaning of potentially competitive herbaceous species has been successful in increasing orchid numbers over time [Waite & Farrell 1998). Annual work parties hand clear sites where rare and or endangered species are known to occur. Hand weeding in the Warrandyte State Park 5 metres around fauna exclusion fences has resulted in an 80% reduction of exotic grasses over a three year period (Coupar & Van Bockel 1998).

Propagation, Translocation and Hand Pollination

Hand pollination is a manipulative technique to be used as an interim measure while further investigation is carried out into the cause of poor natural pollination. In cases of rare or endangered species, it may be necessary to undertake hand pollination due to diminishing levels of natural pollination events. This can increase the success of a species in setting seed. Hand pollination in the Warrandyte State Park has been carried out on two species and 88% of plants that were manipulated produced a fruiting capsule (Coupar & Van Bockel 1998). Hand pollination in certain populations of the lady’s slipper orchid in Britain has taken place every year since the 1970s and in general,

seed capsule production is good (Ramsay & Stewart 1998). The aim is for successful re-establishment and that eventually hand pollination not be required.

Plants can be collected from areas which will be subject to clearing. In Brazil epiphytic orchids were cut from felled trees and replaced on host trees in a reserve. During the first six months after transplantation, about 40 metres of roots were produced per colony and most plants flowered within a year (Warren 1989). In Australia in 1987, approximately 1000 orchid tubers were removed from an area of bushland in Eltham, Victoria that was about to be sub-divided and transplanted into Warrandyte State Park. The Slaty Helmet-orchid *(Corybas incurvus)* presumed extinct in the park, was subsequently found to re-establish and flowered at the transplant site although the majority of the other transplants failed to survive (Coupar & Van Bockel 1998).

Conservation strategies for over-collected ornamental species must include propagation projects (Sosa & Platas 1998). In a Brazilian conservation project a high measure of success was achieved when laboratory-reared and nursery-established seedlings were re-introduced to areas where species have been lost by previous over-collection in the last century (Warren 1989). Herbariums and laboratories in Britain have experimented with orchid germination and propagation and then identified suitable sites for re-introduction of species successfully grown (Farrell & Fitzgerald 1989).

On-going monitoring

Successful conservation of rare species must be based on sound knowledge of their ecology. A crucial component of this knowledge is an understanding of the population biology of the species and the dynamics of the particular population of concern. In order to predict how populations will expand or contract over time an understanding is required of the factors influencing the abundance and movement of the species and its distribution limits (Carey 1998). Annual censuses of plant populations can be an effective and practical way of monitoring threatened populations. By conducting the census during the flowering season and recording the number of flowering plants present and the number of flowers produced per individual the relative success of individuals and potential for future population growth can be assessed (Sanger & Waite 1998). Censuses also provide an opportunity for understanding temporal variation which gives information on the potential for local population extinction (a highly variable population is expected to have a higher probability of extinction over a given period of time) and provides insights into population regulation (Gillman & Dodd 1998). Prolonged periods of population monitoring also allows the effectiveness of conservation management strategies to be assessed. In most cases, site management resulted in an increase in plant numbers and sometimes in species diversity (Coupar & Van Bockel 1998: Waite & Farrell 1998).

In Britain, an Orchid Wardening Scheme was initiated to protect the sites of the rarest orchid species. The scheme was very successful. No orchids were dug up or damaged and over l000 people visited wardened sites and were told first hand about research that was being carried out. This encouraged interest, positive publicity and increased public awareness of the associated conservation problems. The presence of a warden during the flowering period I also enabled detailed biological observations to be made on topics such as insect visitors and pollination rates (Farrell & Fitzgerald 1989).

Smoke and Fire

Fire in some southern indigenous Australian species is necessary for seed germination with these species flowering in response to fire. Ecological burns may therefore be required for conservation of populations. Burns have been used as a management tool to protect the orchid flora in the Warrandyte State Park, Victoria (Coupar & Van Bockel 1998). Another method involves the use of smoke water *(ie* spraying the ground with water treated with smoke) to encourage germination of indigenous seeds in the soil (Coupar & Van Bockel 1998).

Terrestrial Indicator Species

Although it is the rare and endangered species that are the focus of surveys and management plans, their rarity makes it unlikely that they will be seen in flora surveys. There are a number of more common species that have large, bright coloured flowers on tall stems that may be seen during their respective flowering seasons. The presence of these species in any particular site can indicate that the site is suitable for a suite of orchids in terms of soil, soil moisture, light and level of competition from other plants. The presence of these common indicator species is at least a sign that some of the rarer species might also be present (Metcalfe 1995).

4.5 Difficulties Specific to Orchid Conservation

Fungi Relationship

Orchid seeds are minute and possess no endosperm or external nutrient tissue and many orchids rely on fungi in order to germinate. When seeds are dispersed in nature, they fall where a fungus may already be present, either in the soil or growing in orchid roots. The fungi aid utilization of organic material in the surrounding soil by the embryo, supplying nutrients that may not be readily available. In order to assist conservation of rare or endangered orchid species by propagation from seed in the laboratory, it is necessary to isolate the associated fungi for each individual species (Ramsay & Stewart 1998). Future management aimed at increasing the germination of specific orchids, may include inoculation of the soil with appropriate mycorrhizal fungi prior to seed set (Coupar & Van Bockel 1998).

Each orchid genus has its own required fungus species for germination. Fungus for the adult plant may not be the same as for the seed. Reinfection by the fungus may be necessary at intervals during the lifespan of the orchid (D. Jones 1993). Therefore the presence of orchids species at a Site is reliant on the presence of the correct fungus in the soil at that site.

Weed Control

The effect of herbicides on orchids is not well documented but it is highly likely that they are susceptible to some sprays used for weed control in forests. Information regarding the susceptibility of orchids to herbicides should be sought (Metcalfe 1995).

Ongoing monitoring

Some species of Orchids have relatively short flowering periods and many species are small and difficult to see (Metcalfe 1995). It can be difficult to estimate the true size of populations of many orchid species as terrestrial orchid seedlings develop underground for extended periods of time. Often individuals remain below ground in a dormant state for one or more successive years and hence this phase is a considerable part of life history. Understanding the dynamics of the underground phase is important for understanding changes in the overall population structure (Rasmussen & Whigham 1998). The size of and recruitment from the dormant phase can affect the dynamics of a population (Sanger & Walte 1998). To obtain reliable estimates of the true population size during a yearly census. plants which become recognized as having been dormant

must be retrospectively added to population counts. Terrestrial orchid populations should be recognised as being composed of below ground and above-ground components as well as of early and late emerging plants species (Sanger & Walte 1998).

Epiphytic orchids can be seen and identified relatively easily at any time of the year however, terrestrial orchids are more difficult to detect. Many terrestrial orchids are only visible for a few weeks and sometimes for only a few days. Complicating this is that like many other Australian species, orchid life history strategies can be seasonal. Many orchid species vary their flowering time from year to year as reproduction can be dependant on rainfall and perhaps fire history. For these reasons, it is highly likely that many more species of orchid exist in a given area of forest than are actually recorded (Metcalfe 1995).

The particular method adopted to monitor rare plant populations is more often a compromise between the need for detailed demographic information and limited available resources (Sanger & *Walte 1998).*

Fire Management

There is only very general information available on the effect of fire on orchid species. Research on the effect of fire on each species is required before it will be possible to make adequate fire management decisions about each species. Steve Clark *(pers.* comm.) of the NPWS is initiating the recovery plan for *Caladenia tesselata* and intends to undertake experimental burns of C. *tesselata* habitat to try and encourage the reinvigorating of declining populations. Such research on orchid response to fire is required for all the targeted orchid species in this survey.

Orchids are known to be affected by fire, both positively and negatively. Summer fires **occurring from December to February are much more effective at stimulating flowering in** orchids than those which occur earlier or later (Jones. 1993). Jones (l988) lists a number of orchids that are inhibited by summer fires, hence variations in fire timing, frequency and intensity will have differing effects on different species. Of the orchids which may be inhibited by summer fires, most are autumn and winter flowering species and the reduction in flowering usually lasts for only one season (Jones 1993).

Since different species of orchids flower in every month of the year it is difficult to nominate a· time when a cool burn will be of least harm to orchids. Regulated burning (to reduce fuel build up and undertaken in the cooler months) does not stimulate flowering and indeed usually has a deleterious effect because it is carried out while the orchids are in active growth and destroys any above ground parts. When fuel build up is high the resulting fires are very hot and often results in the dramatic flowering of orchid species (Jones 1993).

Jones (1993) discusses the effects of fire on orchids in reference to summer fires only. This is probably because many terrestrial orchid species are dormant over summer and less susceptible to damage from fire and that fires naturally occur more frequently in summer. In eastern Australia there are only three species which can be said to be fire dependant *(Lyperanthus nigricans, Bumettia cuneata* and *Caladenia menziesii)* some orchid species may be stimulated by summer fires, these are mainly spring flowering species (Jones 1993).

In more open woodland sites large logs often provide a micro-habitat for orchids that are adapted to moister conditions. Old logs provide a shaded strip which remains moister for longer than the general floor of the forest. These micro-habit logs are easily burnt and the resulting hot fire kills off the orchid tubers in the ground adjacent to the log. Jones (1993) states that some dormant tuberoides will certainly be destroyed by fires this way but probably not a high

proportion. Though continued burning progressively eliminates these quite important micro-habitats for terrestrial orchids.

There is conflicting literature on the effect of fire on some genus. In Jones (1993) it is stated that species of *Microtis* are an enigma with *M.· Unifolia,* M. *parviflora* and M. *rara* frequently stimulated by fires and producing extensive populations of vigorous plants and at other times they are reduced or absent after a burn. While Bates (1986) states that all species of *Microtis* flower prolifically after fire. In the *Microtis angusii* recovery plan (NPWS 1999), it is stated that burning trials are required before the response of M. angusii to fire is fully understood and that these trials will not be undertaken until more information is known about the ecology and structure of the known populations.

A cautious approach is required for all management options.

REFERENCE REQUIRED - (Jack Baker Journal of Ecology). There was a theory that heathland needed to be burnt every eight years to provide adequate habitat for the endangered Eastern Bristle Bird. Jack Baker's research found that this was not necessarily true. All historical data of fires in all known Bristle Bird habitat was assessed and it was found that areas that hadn't been burnt for over 16 years had *higher* populations of Eastern Bristle Birds that those areas burnt more regularly. This example illustrates the need for research into fire management of orchids as well as undertaking trial experiments for any changes to be made to the management of a habitat.

5 ORCHID SPECIES

5.1 Genus *Cryptostylis*

5.1.1 Cryptostylis hunteriana Leafless Tongue Orchid

Flowering Time
December to February

Conservation Status
Listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995).

Biology
C *hunteriana* is a leafless saprophytic herb, independent of fire, but dependant on the availability of decaying matter and micorrhizal fungi (J. Riley *pers comm).* "A saprophyte is a leafless plant which lacks chlorophyll and survives by an intimate symbiotic relationship with a micorrhizal fungus in its roots. It relies entirely on the symbiotic fungus to digest and transport substances into their roots. These materials are in turn obtained from organic matter decaying in the soil". (Jones 1988)

Distribution
Found from far-eastern Victoria (Cann River) to north-eastern NSW (Gibraltar Range north-west from Grafton) (Jones 1988) and one plant was recently discovered in 1998 at Tinnanbar QLD flowering out of season in winter and growing on a small mound of whitish sandy soil in a coastal habitat.

Habitat
In NSW it occupies habitats from scrubby swamp fringes to steep bare hillsides in tall eucalypt forest. Recorded from only a few locations. (Bishop 1996)

In previous years it was found in the Wyong Shire at sites with *Eucalyptus haemastoma, Angophora costata, Eucalyptus capitellata* and *Angophora inopina* open woodland with *Themeda australis, Danthonia* species and *Patersoonia sericea* open grassland and with Spotted gum *Eucalyptus macculata, Eucalyptus haemastoma,*

Angophora costata open forest and *Melaleuca nodosa* mid canopy with heathland with *Themeda australis* and *Danthonia* species present.

In the Wyong Shire *Cryptostylis hunteriana* was found on Patonga Claystone, sand to clay.

Potential habitat within Wyong Shire
It can occur anywhere that *Cryptostylis subulata* or *Crytostylis erecta* occur as long as it is not swampland (pers comm. J. Riley). Site where *Cryptostylis subulata* or *Crytostylis erecta* were found at include sites: 22, 2, 3, 4, 5, 6, 7, 9, 13,9, 7, 37, 33, 28,23,53, 43, 41, 38, 55, 52, 47, 45, 44.

Vegetation codes for known sites
2 = Rnm2
3 = Rnul
22 = Rnul

Known populations within the Shire
Note, there are no recent records of C. *hunteriana* in the Shire.
Site 2. Chain Valley Bay (J. English, 1996/97] population size = 1 plant.
Site 3. Behind Council depot, Arizona Rd. (J. Riley 1979) pop size = 3 clumps of 10 spikes.
Site 22. Health Department, Moala Rd. (B. Branwhite. 1990) pop size = 2 plants.

Known populations outside the shire
- Awaba State Forest, Freemans Waterhole. S. Bell (1995) pop size = 15 plants.
- Nelson Bay (J. Riley. 1997) area = 30 to 40 plants distributed through half of an acre.
- Lemon Tree Passage (J. Riley. 1997) = 50 spikes
- Turn-off to Pigeon House Mountain. (J. Riley. 1996) = 20 plants
- Manyana Bendalong turnoff (J. Riley. 1996) = 20 plants.
- Kemplin (J. Riley. 1998) 2-3 plants.
- Wyee Rail Loop (S. Bell. 1997) pop size = 3 plants.

5.2 Genus *Diuris*

Ecology
Species of *Diuris* are very widespread in grassy habitats but easily missed because of their short flowering seasons - usually no more than 2 weeks. Many species are associated with Kangaroo grass. *(Themeda australis).* Their colourful flowers appear to be pollinated mainly by small bees but syrphiid flies and beetles may also be pollinators. The flowers offer no reward to pollinators (ie, no nectare) and often appear to mimic other plants growing nearby (which offer nectare as a reward to the pollinator), thereby tricking pollinators into visiting them. Most of the *Diuris* species mimic the pea flowers in the genera *Daviesia* and *Pultenana.* Their ability to adapt to the form of the more abundant pea species in their vicinity is a cause of considerable taxonomic confusion and debate concerning species boundaries. Furthermore, many populations show an extraordinary range of floral forms, perhaps the result of natural selection favouring rarer flower, types that the pollinators have less chance to learn to recognise as being unrewarding (T. Bishop 1996). This explanation may explain why the flowers on a single stem can vary dramatically from each other. Current research is investigating the presence of ultra-violet reflecting spots on *Diuris* flowers as attractants for pollinators most insect pollinators only see in the ultra violet light spectrum.

Botanical Description
The genus Diuris is entirely restricted to Australia with the exception of a single poorly known species in East Timor. Species are distributed throughout every state except the Northern Territory. They are terrestrial herbs sympodial (produce a new shoot each year) and have tubers. Diuris are commonly called Doubletails or Donkey orchids (T Bishop 1996).

5.2.1 Diuris praecox Rough Double Tail

Flowering Time
July - early August

Conservation Status
Diuris praecox is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995).

Biology
Diuris *praecox* is a terrestrial orchid which grows along the coast and is early flowering. Most diuris species *exist* as subterrain tubers during most of the year. D. praecox produces leaves and the flowering stems in winter to mid winter. *Diuris praecox* uses floral mimicry to achieve the pollination of its flowers.

Distribution and Habitat
Known from coastal areas between Ourimbah and Nelson Bay, growing in eucalypt forest, often on hilltops or slopes (T. Bishop 1996).

In the Wyong Shire it is located *Eucalyptus haemastoma, Angophora costata* and *Allocasuarina littoralis* open woodland with open grassland and sedgeland with *Patersonia sericea, Themeda australis* and *Danthonia* species and *Angophora costata, Melaleuca nodosa* and *Allocasuarina littoralis* forest.

Soil Landscape
In the Wyong Shire *Diuirs praecox* was found on Patonga Caystone, Indurated sand and Munmorah conglometrate.

Potential Habitats within Wyong Shire
Vegetation codes for known sites =
3 = Rnul
47 = Qs3
54 = Rnm4

Known Habitats in *the Wyong Shire*
Diuris *praecox* was found at three survey sites (sites 3, 47 & 54) in previous seasons.
Site 47 Norah Head, B. Branwhite, pop size = 6 plants(1996) & pop size = 1 plant (1999).
3 Behind Council Depo - Arizona Rd. B. Branwhite (1999) pop size = 1 plant.
Close to site 54. Wallorong Peninsular Sth of quarry (1999) 12 = plants B. Branwhite
Munmorah State Recreation Area (George Hillman 1996) population size = 50 to 60 plants in little colonies throughout the area.

Known habitats outside the Shire
Marywhether Heights (type site)
Glen Rock Reserve
Anna Bay
Nelson Bay
Used to be in Black Rock Reserve

Management issues
Threatening processes affecting critical habitat at site 47 include a high level of weed invasion, uncontrolled track expansion and erosion of existing tracks by trail bikes.

5.2.2 *Diuris* aff1 *aurea* / Diuris aff *chrysantha*

Sample were sent by B. Branwhite to D. Jones of the Orchid Research Group of the CSIRO to be identified. Samples ORG 928 and ORG 930 (1997) were identified as D. *aff chrysantha.* J. Riley believes that the *Diuris* aff *aurea* and D. aff *chrysantha* are all D. *aurea,* claiming that the different flower shapes are due to the *Diuris* pollination strategy. The closely related I air. is used to denote an undescribed species closely related to a described species.

species Diuris *chrysantha* is not found in this shire. Its southern distribution ends in
Northern NSW (D. Jones 1993).

Flowering Time
August to October.

Conservation Status
Uncommon in Wyong.

Biology
All species of *Diuris* are terrestial herbs that reproduce by seed and vegetative processes. All species of Diuris are deciduous and die back to fleshy tuberoid to avoid the summer extremes of dryness and heat. Tuberoides sprout after soaking rains, in the autumn and the leaves fully develop before the inflorescence is produced. Replacement tuberoides are produced by all species and many increase vegetatively by daughter tubeoides (D. Jones 1993).

Distribution
Diuris aff *aurea / Diuiris* aff *chrysantha* are as yet undescribed species and therefore no information of their current distribution is known. B. Branwhite suggests that this species is rare in the Wyong Shire and not conserved well.

Habitat
Open heathland with Themeda australis (B. Branwhite pers comm.)

In the Wyong Shire *Diuris* aff *aurea / Diuris* aff *chrysantha* was found *in Eucalyptus haemastoma, Eucalyptus capitellata* and *Allocasuarina littoralis* open woodland with open heathland containing *Patersoonia serices* and *Xanthorrhoea* species.

Soil *Landscape*
Within the Wyong Shire *Diuris* aff *aurea / Diuiris* aff *chrysantha w*as found in Munmorah Conglomerate, Patonga Clay, Indurated Sand.

Potential Habitat within the Wyong Shire
Open heath with *Themeda australis* present.
Vegetation codes for known sites =

46 = Rnul
47 = QS3
45 = Rnul
27 = Rnm2
21 = Rnm2
51 = Rnm4

Known Populations within the Shire

46 San Remo Site. 2 hectares of plants in open woodland and open heath
47 Norah Head (1999) B. Branwhite 1 acre consisting of 12 plant. (1997) same location but consisting of 4 hectares of 1000s of plants.
45 Statford Ave Lakehaven
27 Munmorah SRA Cabbage Tree Rd
21 Chain Valley Bay Sewage Depot
51 Cabbage Tree Rd Munmorah NP

Threatening Processes

Site 46 has High to Severe levels of Clearing. Site 47 has High to Severe levels of Weed Infestation.

5.3 Genus *Microtis*

The genus *Microtis* consists of 12 species distributed mostly over the temperate parts of Australia with three species occurring in the eastern tropics (Dockrill 1992). The genus is named after the small ear like lobes or "articles" on each side of the another and comes from the Greek *micros* meaning small and *ous,* an ear (Cady and Rotherham 1970). M. *angusii* honours Mr Reginald James Angus an Orchidologist who discovered the species in 1987 (Jones. 1996). *Microtis* species are commonly called "onion orchids". This refers to the leaves which are cylindrical like those of plants of the onion family (Bates 1986)" (NP&WS 1999).

5.3.1 Microtis angusii
May possibly be renamed, but will still remain an endangered species.

FLowering Time
September to October.

Conservation Status
M. *angusii* is considered a endangered species due to its extremely low numbers existing in only two populations.

Description
M, *angusii* is distinguished in the field by its more robust habit and larger size and on closer examination, by floral characteristics. It is possible that the species has been misidentified in the past and more populations may *exist* (NP&WS 1999).

Biology
M. angusii exists as a subterranean tuber during most of the year. It produces leaves and then flowering stems in late winter and early spring. Flowers from May to October (Jones 1994). In *Microtis* the flowers mature from the bottom of the inflorescence to the top and the capsules at the bottom of the raceme may have already released their seed before the flowers at the top have opened (Bates 1986). By summer the aboveground parts have withered leaving no parts aboveground (NP&WS 1999).

Reproductive Biology
Most species use a '3 chance' system for reproduction from seed (Bates 1986). These are the use of insects as pollination vectors. self fertilization of flowers (Autogamy) and possibly production of seed without pollination (Apomixix).

• Pollination Vectors: -In *Microtis* species the flowers have a nectary at the base of the labellum and are lightly perfumed. This makes them attractive to small insects. Observations in the field have shown that beetles, flies, ants and wasps visit *Microtis* flowers (Bates 1986). No pollinators have been observed for M. *angusii* to date (R Angus pers. Comm.) (NP&WS 1999).

It is likely that M. *angusii* reproduces vegetatively in the same manner as that of other *Microtis* species by the formation of 'daughter' tubers from the main tuber (Peakall & Beattie 1989). The tubers sprout in Autumn, grow slowly through Winter in dry environments and rapidly through spring (Bates 1986: Murphy 1993)

Current Distribution
Endemic to NSW and currently only known from its type locality at Ingleside in the north of the Sydney Metropolitan area and from a population from Sunny

Corner State Forest near Bathurst (J. Riley pers. Comm, NP&WS 1999) and possibly from Chain Valley Bay, Wyong.

Habitat in the Wyong Shire
In Wyong M. *angusii* was found on the western perimeter of a wet heathland/sedgeland (Qa8) and the upslope of *Angophora costata, Corymbia gummifera, Eucalyptus haemastoma, Eucalyptus capetellata, Eucalyptus piperita, Eucalyptus umbra* open forest (Rnm2)(S. Duncan pers. comm. 1999).

Potential Habitat
Not easy to define as the Ingleside location and the Sunny Corner population are in highly disturbed sites (NP&WS 1999). In Wyong potential habitat is the western edge of wet heathland/sedgeland Qa3 where it joins open forest Rnm2.

Vegetation codes for known sites =
44 = Qa8
2 = Rnm2

Soil Landscapes
In Wyong, found on the junction of Doyalson and Wyong Soil Landscapes. The Doyalson Soil Landscape occurs on Munmorah Conglomerate and consists of moderately deep yellow earth and yellow podozoic soils with gleied pozoic soils on drainage lines. The Wyong Soil Landscape consists of soils on poorly-draines alluvial flats on quaternary alluvium. These soils are deep yellow podzoic soils and brown podzoic soils (Murphy 1993).

Known *locations within the Shire*
Site 44. South of Warnervale School. pop size = 5000
(B. Branwhite 1999)
Site 2. Behind Scout Hall Chain Valley Bay (1996/97) J. English.
population size = 20 plants

5.4 Genus *Caladenia* Fairy Orchids, Spider Orchids

Introduction
There are 104 species of Caladenia (plus atleast 8 recently named ones) in Australia occurring in all states except the Northern Territory. The taxonomy of this genus is confused and current thinking is that more species deserve to be described but there are difficulties in delineating the limits of the various forms (T. Bishop 1996).

5.4.1 *Caladenia tessellata* Thick lipped Spider Orchid
Flowering Time
September to October.

Conservation Status
Listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995).

Biology
All of the *Caladenia* genus are terrestial herbs which produce a new shoot each year (sympodial) from a subterrainian tuber. The Spider orchids are generally pollinated by pseudocopulation, the agents being male thynnid wasps attracted by a pheromone mimic produced by the glandular tips of the sepals. C. tesselata is pollinated by an as yet undescribed Black Wasp of the family *Phymatothyninus* which is abundant at Fraser's Beach access road.

Distribution
It is known in New South Wales and Victoria. In NSW *Caladernia tesselata* occurs from Swansea south in coastal areas of NSW, generally very sporadically distributed and rare and extending onto tablelands in the south (T. Bishop 1996).

Habitat
Favours low open forest with a healthy or sometimes grassy understorey (T. Bishop 1996) Coastal heathland.

Soil Landscape
Munmorah conglomerate, indurated sand and clay and Patonga claystone.

Potential Habitat
In the Wyong Shire includes coastal heathland. Norah Head, Munmorah NP and any similar habitat to site 48, which is approximately 12 kilometres from the coast in heathland with open forest on a hilltop and contains vegetations communities Rnul and Rnu2 and Qa4.

Vegetation codes for known sites =
43 = Rnm3
47 = Qs3
48 = Qa4

Soil Landscape
Munmorah conglomerete indurated sand and clay and Patonga claystone.

Known locations within the Shire:

Site 43. Fraser Park. Munmorah NP. pop size = 1 (1999).
Site 43. Fraser Park. (C. Bower. 1992 -1993). pop size = 20 plants along bank and along walking track to headland and a large population of the pollinator species for *Caladenia tesselata* (an as yet undescribed species of Black Wasp *Phymatothynnus* species) was also located nearbv 1992.
Site 47. Norah Head and Sisters Beach (B. Branwhite, 1996 & 1997) population size = 2 plants at two locations.
Site 48. Extrative industry site (1990) S. Nash population Size = 1 plant

C. *tesselata* was recorded in the Wyong Shire in 1953 by L Holmes, but no record of the population or location was made (Botanic Garden Herbarium record).

Known locations outside the Shire.
Steve Clarke (1999) relocated C *tesselata* at Braidwood on private property, currently there are 7 plants but ten years ago there were 100 plants. Attempts to relocated populations at Ulladulla and Jervis Bay were unsuccessful (Steve Clarke. NPWS southern Region. *Pers. comm)*

Herbarium collections:

NSW Collections

H.M.R Rupp. s.n. Aug 1944
34 Deg 1 Min 0 Sec S
151 Deg 4 Min 0 *Sec* E
Jannali

G.V. Scammell 15 Sep 1923
32 Deg 1 Min 0 Sec S
115 Deg 52 Min 0 *Sec* E
Como

E. Nubling, s.n. Sep 1928
34 Deg 3 Min 0 Sec S
151 Deg 3 Min O Sec E
Loftus

E. Nubling. s.n. Sep 1928
34 Deg 3 Min 0 Sec S
151 Deg 3 Min 0 *Sec* E
Loftus. National Park

L. Holmes Sep 1953
33 Deg 16 Min 0 Sec S
151 Deg 25 Min 0 Sec: E
Wyong

E. Betche Oct 1900
33 Deg 30 Min 0 Sec S
151 Deg 10 Min 0 Sec E
Hawkesbury River

J.L. Boorman October 1902
33 Deg 37 Min 0 Sec
151 Deg 9 Min 0 Sec
Berowra

H.M.R Rupp Sep 1945
33 Deg 48 Min 0 Sec S
151 Deg 13 Mins 0 Sec E
Castlecrag. Middle Harbour

E. Betche Sep 1883
33 Deg 51 Min 0 Sec S
151 Deg 16 Min 0 Sec E
Port Jackson

E. Cheel 29 Sep 1901
33 Deg 58 Min 0 Sec S
151 Deg 4 Min 0 Sec E
Penshurst

H.M.R Rupp Sep 1944
34 Deg 1 Min 0 Sec S
151 Deg 4 Mins 0 Sec E
Jannali near Como

W. Schmidt
34 Deg 1 Min 0 Sec S
151 Deg 4 Min 0 Sec E
Sutherland Cemetery

H.M.R Rupp Oct 1945
33 Deg 48 Min 0 Sec S
151 Deg 13 Mins 0 Sec E
Castlecrag. Middle Harbour

A Rupp & H.M.R Rupp Sep 1945
33 Deg 48 Min 0 Sec S
151 Deg 13 Mins 0 Sec E
Castlecrag. Middle Harbour. Port Jackson

E. Betche Sep 1893
33 Deg 55 Min 0 Sec S
151 Deg 9 Min 0 Sec E
Tempe

H.M.R Rupp Oct 1945
34 Deg 1 Min 0 Sec S
151 Deg 7 Mins 0 Sec E
Caringbah. Port Hacking

H.M.R Rupp Sep 1944
34 Deg 1 Min 0 Sec S
151 Deg 4 Mins 0 Sec E
Jannali

H.M.R Rupp & M. Moodie 26 Aug 1942
34 Deg 1 Min 0 Sec S

APPENDIX III
ORCHID ASSESSMENT SHEETS

1. Threatened Flora Site Assessment (new site)

DATE: RECORDER:

THREATENED SPECIES:

LOCATION (description:

Map number/sheet	
Grid Reference	
Accuracy:	

SITE DESCRIPTION:

Land Tenure	Local/state/federal government/freehold/National Park/other
Topography	Ridge/upper slope /mid slope/gully/wetland/other
Understorey	Developed/suppressed
Current Land Use	
Past Land Use	
Time Since Last Fire/Fire History	

POPULATION DETAILS: (follow with an E if an estimate)

Local Abundance	Frequent/occasional/rare
No. of adult plants	
No. of seedling plants	
Area covered by sub-population (m)	
Plant Distribution	Small scattered clump/large continuous clump/other
Breeding Status	Buds / flowers / fruit

HABITAT CHARACTERISTICS:

ASPECT: SLOPE: ALTITUDE:

GEOLOGY:

Soil Landscape/Type:	
Texture:	Sand/loam/clay
Drainage:	Waterlogged/damp/well drained dry/well drained moist
Depth	Skeletal/shallow/deep
Disturbance:	Intact/topsoil removed/landfill/other

VEGETATION STRUCTURAL FORMATION:	TM (Open Forest)	TS (Woodland)	TV (Open Woodland)	TD (Closed Forest)

(refer to Atlas of NSW Wildlife Field Data Book)

SPECIES ASSOCIATIONS (list dominant species):

- Canopy:

- Understorey:

- Groundcover:

- Vines/Climbers:

- Other Threatened Flora/Fauna Species Recorded:

THREATS:

Weed invasion	(specify species): % cover
Trampling/Grazing	: feral/domestic/native
Isolation/fragmentation	
Erosion	
Inappropriate Fire Regimes	
Fire trail maintenance	
Rubbish dumping	
Other	(specify)

OTHER RECORDS:

Collection Made	Yes / No
Type of Collection	Seed / cutting / plant
Photographs taken	Yes / No
Extent of Survey	Complete / incomplete / unknown

OTHER OBSERVATIONS:

2. *M. angussi* monitoring proforma

DATE: RECORDER:

Site Name:

Location:

Monitoring year: 1 2 3 4 5

Total number of adult plants:

Total number of seedling plants:

Plant population census

Map Co-ordinate	No. of Plants	Plant Status	No B/FI	No Fr	Notes
e.g, A5	13	13A	10F1	3	Evidence of fruit predation by caterpillars on two plants