NATIONAL RECOVERY PLAN FOR ANGUS'S ONION ORCHID

Microtis angusii







Recovery Plan for Angus's Onion Orchid (Microtis angusii)

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Department of Environment, Climate Change and Water (NSW) 59-61 Goulburn Street PO Box A290 Sydney South NSW 1232

Phone:	(02) 9995 5000 (switchboard)
Phone:	131 555 (information & publication requests)
Fax:	(02) 9995 5999
Email:	infor@environment.nsw.gov.au
Website:	www.environment.nsw.gov.au

Requests for information or comments regarding the recovery program for *Microstis angusii* are best directed to:

The *M. angusii* Recovery Plan Co-ordinator Biodiversity Conservation Section, Metro Branch Department of Environment, Climate Change and Water (NSW) PO Box 1967 Hurstville NSW 2220 Phone: 02 9585 6952

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Recovery Plan Angus's Onion Orchid (Microtis angusii)

Foreword

This document constitutes the formal National Recovery Plan for *Microtis angusii* (Angus's Onion Orchid) and, as such, considers the conservation requirements of the species across its known range. It identifies the actions to be taken to ensure the long-term viability of *M. angusii* in nature and the parties who will undertake these actions.

M. angusii is a terrestrial orchid that grows to about 60 cm tall. The current distribution is extremely restricted. It is known from one small population in a roadside reserve at Ingleside in northern Sydney. *M. angusii* is listed as endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and endangered on the NSW *Threatened Species Conservation Act 1995*.

The recovery actions detailed in this plan include habitat protection and management of threats, surveys in potential habitat for the species, research into its ecology, and *ex situ* conservation. It is intended that the recovery plan will be implemented over a five-year period. The Department of Environment, Climate Change and Water will undertake the actions in the plan in consultation with the Roads and Traffic Authority, Warringah Council and the NSW Rural Fire Service. The total cost of implementing the plan is \$114,750 over a five-year period (Table 1). Implementation of recovery actions is reliant on securing funding.

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Mr Reginald Angus who shared local knowledge and personal information about the species and for provision of photographs of the species and its habitat.

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Dr Peter Weston of the NSW National Herbarium for advice and discussion on the genus *Microtis*.

Dedication

Reg Angus passed away on the 6th March 2000 after a long illness. Reg's passion for native orchids began in the mid-1980s. He quickly learned that the native bush around where he lived was abundant with various species of orchid. He promptly joined the local native orchid group: The Australasian Native Orchid Society – Warringah Group. In 1988/89, with the help of Warringah Council, Reg put together a book entitled, *The Native Orchids of Warringah*. This book contained the names and descriptions of as many orchids as he and other members from the Group could find in the local area.

During one of his many walks, he came across an orchid that had not been described before: *Microtis angusii*. The species was named in honour of Reg who was tireless in protecting the site at Ingleside and monitoring the population.

Reg always had time to talk to those who became interested in native orchids and helped beginners endlessly. Reg had many hobbies including bird watching and photography and both of these show his enthusiasm for our natural bush heritage, one we should all enjoy.

The Recovery Team would like to sincerely thank Reg for his dedication to this species and for enlightening us all to the beauty of small cryptic things.

Recovery Plan for Angus's Onion Orchid (Microtis angusii)

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1 Introduction

Microtis angusii (Angus's Onion Orchid) is a terrestrial orchid that grows to about 60 cm tall. The current distribution is extremely restricted: it is known from one small population at Ingleside in northern Sydney.

This document constitutes the formal national recovery plan for *M. angusii* and, as such, considers the requirements of the species across its known range. It identifies the actions to be taken to ensure the long-term viability of *M. angusii* in nature and the parties who will undertake these actions. The attainment of the objectives of this recovery plan are subject to budgetary and other constraints affecting the parties involved.

This plan has been prepared by the NSW Department of Environment, Climate Change and Water (DECCW) with the assistance of a recovery team (a nonstatutory group of interested parties with relevant expertise), established to discuss and resolve issues relating to the plan. Components within the plan do not necessarily represent the views or the official positions of all the individuals or agencies represented on the recovery team. The information in this recovery plan was accurate to the best available knowledge on the date it was approved.

2 Legislative context

2.1 Legal status

M. angusii is listed as an endangered species on Schedule 1 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and as a nationally endangered species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

2.2 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides a legislative framework for the protection of threatened species across Australia.

As *M. angusii* is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the relevant Commonwealth Minister for consideration. The Minister will then decide whether the action requires EPBC Act approval. This is in addition to any State or Local Government approval required.

Administrative guidelines are available from the Commonwealth Department of Sustainability, Environment, Water, Population and Communities to assist proponents in determining whether their action is likely to have a significant impact: www.environment.gov.au/epbc/guidelinespolicies.html.

2.3 Threatened Species Conservation Act 1995

The TSC Act and subsequent amending legislation (hereafter referred to jointly as TSC Act) provide a legislative the framework to protect and encourage the recovery of endangered and vulnerable species, endangered populations and endangered and vulnerable ecological communities in NSW. Under this legislation, the Director General of DECCW must prepare a Threatened Species Priorities Action Statement, which outlines a strategy for the recovery of each listed threatened species in NSW. The strategy for any particular species may include the requirement for a recovery plan to be prepared, however this is no longer a mandatory requirement for every threatened species.

The actions identified in this plan for the recovery of *M. angusii* in NSW are the responsibility of DECCW and have been endorsed by the NSW Department of Planning, Warringah Council, Pittwater Council and the NSW Rural Fire Service. Public authorities with core legislative responsibilities relevant to the protection and management of *M. angusii* and its habitat are listed in Appendix 1.

2.4 Consultation with Aboriginal people

Local Aboriginal Land Councils, Elders and other groups representing Aboriginal people in the area where *M. angusii* occurs have been identified and a copy of the draft recovery plan has been sent to them. Their comments have been considered in the preparation of the final recovery plan. DECCW will consider the role and interests of these Aboriginal communities in the implementation of the actions identified in this plan.

2.5 Critical habitat

The TSC Act makes provision for the identification and declaration of critical habitat for species, populations and ecological communities listed as endangered. Once declared, it becomes an offence to damage critical habitat (unless the action is specifically exempted by the TSC Act). A Species Impact Statement (SIS) is mandatory for all developments and activities proposed within critical habitat.

Similarly, under the EPBC Act, critical habitat may be registered for any nationally listed threatened species or ecological community. To date, critical habitat has not been declared for *M. angusii* under the TSC Act or the EPBC Act. DECCW considers that there is not enough information on the species or its habitat requirements at this time to consider TSC Act critical habitat declaration.

2.6 Key threatening processes

Competition and grazing by the feral European rabbit is a key threatening process listed under both the TSC and EPBC Act and is relevant to *M. angusii*. The invasion of native plant communities by exotic perennial grasses is also listed as a key threatening process under the TSC Act and is impacting on the species at Ingleside.

In addition, other processes are recognised as threatening the survival of the species in NSW. These are discussed in Section 4.

2.7 Licensing

Any activity not requiring development consent under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) that is likely to impact on *M. angusii* or damage its habitat, requires a licence from DECCW under the provisions of the TSC Act or NSW *National Parks and Wildlife Act 1974* (NPW Act) as a defence against prosecution. If the impact is likely to be significant, a Species Impact Statement (SIS) is required.

2.8 Other conservation measures

The TSC Act includes provision for other measures that may be taken to conserve *M. angusii* and its habitat, including the making of a Stop Work Order or Joint Management Agreement. For information regarding the role of other legislation relevant to *M. angusii* see Appendix 2.

3 Species information

3.1 Description and taxonomy

M. angusii belongs to the family Orchidaceae. This cosmopolitan family consists of about 25,000 species worldwide, many of which are of commercial value as living and cut flowers and for culinary purposes, e.g. the vanilla bean (Weston 1993).

The genus *Microtis* consists of over 20 named species distributed mostly over the

temperate parts of Australia with three species occurring in the eastern tropics (P. Eygelshoven, pers. comm.; Dockrill 1992). The genus is named after the small ear like lobes or auricles on each side of the anther 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).

Four named species of Microtis are known to occur in the Warringah-Pittwater area, M. parviflora, M. unifolia, M. rara and M. angusii. Two species, M. parviflora and M. unifolia, are relatively common and widespread, they are similar in appearance and can be confused with each other. M. rara can be identified by its larger labellum and tendency to flower in the following season а bushfire (P. Eygelshoven, pers. comm.). M. angusii is distinguished in the field by its more robust habit and larger size and, on closer examination, by floral characteristics. However, it is possible that the species has been misidentified in the past and more populations may exist. For further information see Appendix 2.

3.1.1 Current distribution

M. angusii is endemic to New South Wales and is currently only known from its type locality at Ingleside in the north of the Sydney metropolitan area (J. Riley, pers. comm.). The currently known distribution of *M. angusii* is illustrated in Figure 1.

Recent survey work may have located individuals of *M. angusii* in a number of Duffys Forest vegetation remnants, though this is yet to be confirmed.

3.2 Land tenure

DECCW (formerly National Parks and Wildlife Service), in consultation with the

NSW Roads and Traffic Authority (RTA) and Warringah Council, carried out a boundary survey of the Ingleside site to determine the ownership of the land on which the Ingleside population occurs. The population occurs within a road reserve in the Warringah Local Government Area. Within a road reserve, the RTA is responsible for the management of the road pavement, while the Council is responsible for management of the remainder of the reserve. Thus Warringah Council is responsible for the management of the population.





3.3 Habitat

3.3.1 Vegetation and potential habitat

It is not easy to define the preferred natural habitat of *M. angusii* as the Ingleside location is a highly disturbed site. At Ingleside, the dominant species occurring on the site are the introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. In the past the site has been

used as a soil depot and a vehicle parking site. It has been cleared of its original native vegetation. One dead native tree exists on site. This is possibly a *Eucalyptus sieberi*.

The population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest, Terrey Hills, Ingleside and Belrose areas. These soils support a specific vegetation type distinct from that occurring on the surrounding Hawkesbury Sandstone soils. This vegetation type, the Duffys Forest Vegetation Community, is listed as an endangered ecological community under the TSC Act and ranges from open forest to low open forest and rarely woodland. Eucalyptus sieberi, E. gummifera, E. haemastoma with E. capitellata or E. globoidea are the species. canopy Angophora dominant costata is also found at a few localities. It is possible that *M. angusii* may be found in other locations that support this vegetation community (Smith and Smith 1997). It is also possible that *M. angusii* is a disturbance specialist as it has not been found in surrounding undisturbed habitat despite extensive searches. Further surveys are expected to assist in understanding the fine scale distribution of the species.

3.3.2 Climate

The climate of the Sydney area varies with topography and distance from the coast. In the northern suburbs of Sydney the average annual rainfall is highest at Turramurra (1,432 mm) with rainfall decreasing westward. Most rainfall is associated with thunderstorms and major fronts (Chapman and Murphy 1989). The average daily maximum temperature in Sydney is 25.8°C in January and 16.1°C in July and the average daily minimum temperature in Sydney is 18.7°C in February and 8°C in July (Bureau of Meteorology 1999).

3.3.3 Landscape and topography

At Ingleside, the population occurs on a ridgetop supporting an iron-rich lateritic soil capping on Hawkesbury sandstone. This soil type has a restricted distribution within the

Duffys Forest, Terrey Hills, Ingleside and Belrose areas of Northern Sydney. This restricted soil type consists of a Hawkesbury Sandstone modified by surface or near surface modification of the iron minerals (Hunt et al. 1977). However, M. angusii is growing in a highly disturbed site that was previously used as a soil depot site for soil extracted from cuttings along Mona Vale Road (R. Angus, pers. comm.). The exact location from which the soil originated is unclear and the fill could have been transported to the current site at any time since the 1950s. Therefore the soil at the known location has been modified and the plants may have been transported as seeds with the soil.

3.3.4 Soil landscape

In the Ingleside, Terrey Hills, Belrose, Duffys Forest area, the soil associated with the iron-rich laterite cappings is known as the Somersby Soil Landscape (Chapman and Murphy 1989). This soil landscape consists of soils that are distinctly orange-red and gravelly, consisting of red and yellow earths with orange-red iron rich pebbles and gravels. At the known locality the soil has been modified. The degree of modification is unclear although at least on one occasion the site has been used to dump sand and has possibly been used as a fill site in the past. *M. angusii* has only been found in modified soils.

3.3.5 Habitat critical to survival

At this time there is insufficient information to accurately define and locate all habitat critical to the survival of M. angusii. Until more is known of the habitat requirement of the species, habitat critical to survival consists of the area of occupancy of the and newly discovered known any populations; areas of similar habitat surrounding the population; and additional occurrences of potential habitat that may contain undiscovered populations or be suitable for future translocations. Recovery actions that will aid in defining habitat critical include research on the species; and identifying, mapping and searching potential habitat.

3.4 Life history and ecology

3.4.1 Life cycle

Most Microtis species, including M. angusii, exist as subterranean tubers during most of the year. M. angusii can occur above ground from April until December (P. Eygelshoven, pers. comm.). M. angusii produces leaves and then flowering stems in late winter and spring, and flowers from May to October (Jones 1996). 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). Figure 2 shows an inflorescence of *M. angusii* and illustrates the progressive nature of the flower maturation. M. angusii produces numerous dehisce fruits, which ellipsoid and presumably distribute seed. By summer the above-ground parts have withered leaving no living parts above ground.

3.4.2 Population structure

Surveys of the population were undertaken from 1998 to 2002, mostly in September and/or October, with variable results (Table 1). The plants occur along a narrow band approximately 10 m wide and 50 m long, in 16 more-or-less discreet clusters of 5 to 80 individuals. The highest population size recorded during surveys was 656 in 2002.

		flowering stage.
1998 Oct.	117	67 in flower, many plants withered, some flower spikes chewed.
1998 Nov.	0	Assumed tubers underground.
1999 Sept.	336	Seedlings and adults, 34 in flower or fruit.
1999 Oct.	214	18 in flower or fruit.
2000 Oct.	358	After site weeded, 150 in flower, several new colonies, plants appear more robust.
2001 Sept.	503	Dry flowering season.
2001 Oct.	120	
2002 Sept	656	
2003 to 2006	<12	Low numbers may have been due to dry conditions and a decrease in maintenance at the site.
2007	0	The weeds at the site were mistakenly sprayed with herbicide.
2007 2008 Sept	0 67	The weeds at the site were mistakenly sprayed with herbicide. 14 in flower, seeds collected from 10 plants.
2007 2008 Sept 2009 October	0 67 79	The weeds at the site were mistakenly sprayed with herbicide. 14 in flower, seeds collected from 10 plants.
2007 2008 Sept 2009 October 2010 Sept	0 67 79 294	The weeds at the site were mistakenly sprayed with herbicide. 14 in flower, seeds collected from 10 plants.

Table 1.	Survey	data
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Year	Total	Comments
1998 Sept.	336	Seedlings and adults, some at pre-

Department of Environment, Climate Change and Water

As a result of the spraying event that occurred at the Ingleside site in 2007, stricter reporting guidelines and protection procedures have been put in place. It is believed that most individuals survived the incident unaffected (P. Eygelshoven, pers. comm.).

3.5 Reproductive biology

3.5.1 Vegetative reproduction

species Most Microtis reproduce vegetatively by the formation of "daughter" tubers from the main tuber (Peakall and Beattie 1989). M. rara, M. parviflora and M. unifolia can produce huge clonal colonies this way (Bates 1986). Microtis species die down by late summer and persist as small tubers. These tubers sprout in autumn, growth is slow in winter in dry environments and speeds up in spring (Bates 1986). In M. parviflora, 1 to 3 tuberoids develop up to 100 mm from the parent each season. Late in the season these separate from the parent so that the clones consist of individual unconnected ramets. Clones rarely exceed 100 cm in diameter and typically consist of 10-20 individuals intermingled with other clones (Peakall and Beattie 1991). It is likely that M. angusii reproduces vegetatively in the same manner (R. Angus, pers. comm.).

3.5.2 Breeding system

Studies of other *Microtis* species have found that most species use a "three chance system" for reproduction from seed (Bates 1986). These are the use of insects as pollination vectors, self-fertilisation of flowers (autogamy) and possibly production of seed without pollination (apomixis). *M. unifolia* is thought to use all three systems of reproduction from seed (Bates 1986), whereas *M. parviflora* is self compatible but not autogamous (Peakall and Beattie 1989). These systems are described in Appendix 2:



Figure 2. Inflorescence of *M. angusii* (Photo R. Angus)

3.5.3 Fecundity

An understanding of fecundity (the quantity of seed produced) is important for many species as it indicates the extent to which a population is sexually reproducing by measuring the amounts of viable seed available for recruitment. It is important to know whether a population of seeding plants is depositing seeds into the seed bank each year. This is particularly important in understanding the viability of small populations that rely on reproduction from seed. In the case of M. angusii, it is likely that the population consist of one or a few genotypes and may be reproducing primarily by vegetative means. Therefore the production of seed may be relatively unimportant (R. Peakall, pers. comm.).

However, *Microtis* species are among the most fecund of orchid species and often have a weedy habit. Time from germination of seed to flowering is usually within twelve months (D. Jones, pers. comm.). It has been observed that most *Microtis* species produce large amounts of fruit (R. Peakall, pers. comm.). Though there have been no scientific studies to date that document the fecundity of *M. angusii* or any other *Microtis* species, like other *Microtis* species, *M. angusii* produces numerous small, erect ellipsoid capsules 5–6 mm long and 3.5–4 mm wide, which contain large amounts of minute seeds (Jones 1996).

Fruit predation

The level and impact of fruit predation on *M. angusii* is not known but is likely to be high. Predation of inflorescences may be a more important factor (R. Peakall, pers. comm.). Caterpillars and grasshoppers have been observed in the field eating the immature fruits (S. Nash and R. Angus, field obs.).

Seed viability, longevity and dormancy

Little is known of the viability and longevity of the seed of *M. angusii*. It is unclear at this stage whether seed is the primary means of propagation for *M. angusii*. Genetic research may help to outline the relative importance of seed in the reproductive process. Most orchid seeds will not germinate in the absence of the appropriate mycorrhizal fungi. M. angusii may require a specific fungus for seed germination although most Microtis species appear to have a loose mycorrhizal association (D. Jones, pers. comm.). In glasshouse trials of other Microtis species at the Australian National Botanic Gardens, Canberra, seeds placed on the surface of well-drained bush soil with some eucalvpt leaf mulch present germinated readily in response to decreasing day length and moisture. Microtis species even colonised the beds of other plant species (D. Jones, pers. comm.).

Seeds were collected by DECCW (Botanic Gardens Trust) from the population in

November 2008 from 10 individuals as part of the Millennium Seedbank Project.

3.5.4 Seedling recruitment

In M. angusii, the natural level of seedling recruitment may be low. It is difficult to distinguish seedlings in the field without excavating the plants to observe the tubers. Natural disturbance regimes may be the trigger for seedling recruitment. It is possible that the current population at Ingleside is the result of a previous recruitment episode in response to a disturbance event. It may even be the result of the recruitment of a single individual (R. Peakall, pers. comm.). Investigation of the genetic diversity of the population will clarify this. It is unclear at this stage what factors might trigger seedling recruitment or what level of seedling recruitment occurs.

3.6 Genetic Diversity

It is important to determine the level of genetic diversity within the Ingleside population in order to determine the most appropriate levels of research to undertake into the breeding system and seed ecology of *M. angusii.*

It is possible that the known population is clonal and could consist of very few or even single genotype. If so then the а management actions in regard to ex situ conservation and ecological research will reflect this. For example, in this case, ex situ conservation of the population will be a relatively simple procedure requiring only a few samples to adequately conserve the full range of genetic diversity. Management actions will still be directed towards protection of the population by threat minimisation, however there will be less need to undertake a comprehensive research program into aspects of the breeding system such as pollination vectors.

3.7 Fire ecology

All species of *Microtis* flower prolifically after fire (Bates 1986), indicating that these plants are stimulated to produce flowers in

response to a fire-related stimulus. This may be due to an increase in light and increased levels of phosphorus and potassium in the soil (Bates 1986). The site of the Ingleside population of *M. angusii* was burnt in 1979, 1989 and 1994 (M. Katz, pers. comm.). Prolific flowering was observed in the field after the 1994 fire (R. Angus, pers. comm.).

Burning trials are required before the response of *M. angusii* to fire is fully understood. These trials will not be undertaken until more information is known about the ecology and structure of the known population of *M. angusii*. In the interim, a cautious approach to fire management should be followed and fire kept out of the known sites until sufficient baseline information has been gathered.

3.8 Ability of the species to recover

The actions in this recovery plan are focused at protecting and maintaining the known populations and discovering and protecting any new populations. Natural regeneration and dispersal will be encouraged though habitat management, including ensuring appropriate fire regimes and protection from degradation.

The consequence of not implementing this recovery program is to maintain the high risk of extinction in the wild over the next 10 to 20 years. Without the co-operation of land managers and planners, *M. angusii* is likely to continue to be adversely impacted by threats as described in Section 4.2.

3.8.1 Species rarity

M. angusii is considered an endangered species due to its extremely low numbers existing in only one population. The number of populations is likely to have been decreased through loss or modification of habitat on the Mona Vale Ridge and within other areas where it may have occurred.

3.8.2 Species viability

There is currently little information as to the viability of the Ingleside population of

M. angusii. The genetic diversity of the known population is unknown and although seed set has been observed, the extent to which this seed is viable and survives in the habitat is unknown.

3.8.3 Likelihood of recovery

In 1997, *M. angusii* was considered one of the most endangered species in NSW. The known population consisted of one individual above ground (R. Angus, pers. comm.), and it occurs in a highly disturbed site subject to a number of threatening processes. The long-term viability of this species was in doubt.

More recently, the known population numbered 656 individuals above ground (in 2002). However, the species is still only known from one population. The site of the population is still extremely vulnerable to threats and *M. angusii* is still inadequately reserved. The population is small and its long term viability is unknown.

From 2003 to 2008 the population is believed to have been largely existing as subterranean tubers from season to season (P. Eygelshoven, pers. comm.). More research and monitoring of the known population is required before the likelihood of the long-term survival of the species is known.

3.8.4 Translocation

Translocation is defined as the "deliberate transfer of plants or regenerative plant material from one place to another, including existing or new sites or those where the taxon is now extinct" (Australian Network for Plant Conservation 1997). Translocation may also involve the removal of plant material to undertake an ex situ conservation Translocation program. programs are usually devised to assist in the conservation of a threatened species, within the context of a broader recovery strategy. Translocation programs can provide a measure of security for critically endangered populations in the event of catastrophes such as the impacts of fire or disease.

The translocation of *M. angusii* is not currently considered to be an appropriate conservation mechanism (except possibly in relation to *ex situ* conservation), due to the lack of ecological knowledge of the species and the means by which to carry out translocation. This may be reviewed in light of further knowledge on the propagation and biology of the species.

M. angusii seeds have been collected and stored as part of the Millennium Seedbank Project. These were collected by DECCW (Botanic Gardens Trust) from the population in November 2008 from 10 individuals.

4 Threats and management issues

4.1 Level of current understanding

There is a lack of knowledge about the biology and ecology of *M. angusii*. Effective management of the species will be much easier if the conditions required for recruitment and the appropriate fire regime for the long-term maintenance of the species in its habitat are known. Research into the genetic diversity of the known population is particularly important.

The Ingleside population of *M. angusii* is in a highly modified habitat so it is difficult to define its optimum habitat. Smith and Smith (1997) predicted that *M. angusii* may occur in the Duffys Forest Vegetation Community of open forest on lateritic soils that occurs in the Duffys Forest, Belrose, Terrey Hills area. Recent survey work may have located individuals of M. angusii in a number of Duffys Forest vegetation remnants, though this is yet to be confirmed. If these are confirmed as M. angusii then the habitat requirements of the species in the Warringah-Pittwater area will become clearer.

4.2 Current threats

4.2.1 Inappropriate fire regime

As the known site of *M. angusii* occurs along a major road, there is great potential for the population to be adversely affected by an inappropriate fire regime. The most likely scenario is too-frequent fire caused by arson, hazard reduction activities and accidental sparking (e.g. from cigarettes).

4.2.2 Habitat degradation related to unrestricted access

Uncontrolled site access has led to rubbish and soil dumping, and soil compaction.

When the species was discovered in November 1987, the *M. angusii* population numbered in the hundreds and extended right to the edge of the road. In 1989 during construction of a sewerage pipe downslope of the population, Sydney Water used the site as a fill dump and placed 10 tonnes of sand on top of the population. When alerted to the presence of the plants they remediated the site by bulldozing the sand over the site and hosing the site with a high pressure hose. Telecom (now Telstra) then used the site as a portable toilet parking area (R. Angus, pers. comm.).

In 1995 the Australian Gas Light Company (AGL) disturbed the site while putting in a nearby pipeline. Upon request, AGL constructed a koppers log fence to keep vehicles and equipment off the site (R. Angus, pers. comm.). AGL constructed the fence with the understanding that Warringah Council would undertake the upkeep of the fence and the site in the future. This has stopped vehicles from driving into the site but does not preclude people or a vehicle at high speed entering the site.

4.2.3 Weed invasion

Weed invasion is symptomatic of degraded habitat. Weeds can out-compete native species in the habitat, particularly in the understorey, and eventually change the nature and function of that habitat to the detriment of the native species that occur there. The weed species of concern at the Ingleside site are *Acacia saligna* and Coolatai grass (*Hyparrhenia hirta*). Any removal of weeds near *M. angusii* plants should take into consideration the possible effects of herbicides on the plant and the timing of any works. Slashing and herbicides should not be implemented during the above ground phase of the *M. angusii* life cycle. *M. angusii* generally occurs above ground between the months of April and December (P. Eygelshoven, pers. comm.).

4.2.4 Unauthorised collection

As a rare orchid, *M. angusii* is a possible target for unscrupulous amateur orchid enthusiasts and professional orchid propagators. It is an offence under the TSC Act to "pick" an endangered plant species without a licence from DECCW. No level of unauthorised collection could be sustained by the population at this stage.

4.2.5 Grazing

During the 1999 flowering season (July), plants at the known site were grazed almost to ground level. Inspections by members of the Recovery Team noted significant grazing on this species and other flora species at the site. Evidence on the site included rabbit scats and diggings, as well as significant bandicoot diggings and some wallaby scats. It was believed by Warringah Council's Pest Species Officer that rabbits were the most likely animal to be damaging the plants. Trapping for rabbits was undertaken by Warringah Council during July-August 1999. No rabbits were caught. If grazing continues then the population may fail to flower and set seed in future seasons. The long-term effect of grazing may be detrimental to the population.

On several occasions, goats were seen on the site (T. Duratovic and P. Eygelshoven, pers. comm. 1999). It is now assumed that the goats were causing the majority of the damage to *M. angusii* at the Ingleside site. The goats are believed to have escaped from a goat farm close to the site. They have since

been captured (T. Duratovic, pers. comm. 2000).

5 Previous recovery actions

There have been no previous recovery plans written for *M. angusii*. However a number of actions have been undertaken prior to and during the preparation of this plan.

5.1 Fencing of the Ingleside population

In response to concerns about vehicles parking on the site and various works being carried out on site to the detriment of the Ingleside population, AGL erected a low, pole fence around the population in 1996 to prevent vehicular access to the site.

5.2 Surveys and monitoring

The Ingleside site was surveyed every year for five years, from 1998 to 2002, with the population and number of colonies increasing over that time. In 1998 the plants were mapped and a site plan was drawn, so the plants could be relocated in subsequent surveys. Intensive surveys were recommenced in 2007 and will continue annually at the Ingleside site.

Other potential sites in Warringah Shire were surveyed July–October 1999 by members of the Australian Native Orchid Society (ANOS) Warringah Group, Warringah Council and the NPWS.

During the 2002 flowering season, further sites were also surveyed for *M. angusii*. No specimens of *M. angusii* were found.

Recent survey work by members of the *Microtis angusii* Recovery Team may have located individuals of *M. angusii* in a number of Duffys Forest vegetation remnants, though this is yet to be confirmed.

5.3 Notification of relevant authorities

As the Ingleside population is located within a road easement and has been subjected to a number of works on site in the past, it was important to notify the relevant authorities as to the importance and sensitivity of the site. The RTA and Warringah Council were notified, as were AGL and Sydney Water. Both AGL and Sydney Water ceased potentially deleterious activities on the site and AGL erected a low fence to prevent the access of vehicles to the site. Warringah Council mows the site to control weeds.

6 Recovery objectives, actions and performance criteria

The overall objective of this recovery plan is to prevent the extinction of *M. angusii* through maintaining self-sustaining populations in the wild in the long term.

Specific objectives are listed below. For each of these objectives a number of recovery actions have been developed, each with a performance criterion. Stakeholders that provided formal endorsement of specific actions to DECCW have been listed under committed agencies for each action. Other stakeholders have been listed as potential contributors.

Objective 1: Co-ordinate the recovery of *M. angusii*

Action 1.1: DECCW will co-ordinate the implementation of recovery actions and will integrate recovery actions with those of other threatened species, populations and communities.

A co-ordinated approach is essential to ensure the recovery plan implementation is timely, cost-effective and efficient. Some of the co-ordination tasks (e.g. liaison with other public authorities) will overlap with other actions. Co-ordination will require liaison and information exchange with Warringah Council, RTA, the ANOS (Warringah Group) and the *M. angusii* Recovery Team.

DECCW will regularly review the implementation and success of the recovery plan, and will use this information, and monitoring results, to re-assess priorities and management actions.

Species with similar management requirements may benefit from the *M. angusii* recovery program. Such species may be subject to a recovery plan in the future and by integrating recovery actions, limited resources can provide better conservation benefits for a range of threatened species.

Committed agencies 1.1: DECCW

Performance Criterion 1.1: DECCW has co-ordinated the recovery actions included in this recovery plan for the life of the plan. Where practicable, recovery actions have been integrated with those of other threatened species, endangered populations or endangered ecological communities.

Objective 2: Protect the known population by minimising the loss and fragmentation of habitat using conservation planning mechanisms

A number of agencies are responsible for the management of the known and potential habitat of M. angusii. As the Ingleside population occurs on council-managed land within the Warringah Local Government Area (LGA), Council is responsible for management of the known population. Also, most of the areas of potential habitat for M. angusii are within Warringah and Pittwater LGAs. These Councils are responsible for environmental assessment the of development that is proposed on private land within their LGA, as well as developing or modifying Local Environmental Plans.

The RTA is responsible for the management of roadworks and road maintenance within

road reserves and easements that may affect potential habitat of *M. angusii*.

Action 2.1: DECCW will negotiate with Warringah Council for the protection of the Ingleside population via an appropriate conservation mechanism. This may be via zoning (see Action 2.3) or a joint management agreement under the TSC Act. Conservation measures will be sought for the protection of any other sites located, in consultation with the relevant land managers/owners and Councils.

Committed agencies 2.1: DECCW and Warringah Council.

Performance Criterion 2.1: An appropriate conservation mechanism will be established by Warringah Council for the Ingleside population. Conservation mechanisms are applied to any new locations.

Action 2.2: Warringah Council will keep a permanent record of the exact location of the Ingleside *M. angusii* population so that due consideration can be given to the species in relation to future activities, plans of management, hazard reduction activities and during emergency fire situations.

Committed agencies 2.2: Warringah Council.

Performance Criterion 2.2: A record of the exact location of M. angusii is established.

Action 2.3: Warringah Council and the Department of Planning (DoP) will ensure that all relevant Environmental Planning Instruments (prepared under Part 3 of the EP&A Act) are prepared, or reviewed, with reference to this recovery plan and any future advice from DECCW regarding the species. Warringah Council will ensure that all known populations of *M. angusii* within the Warringah LGA (including the Ingleside site) exist on the Biological Constraints Layer and/or are zoned as E2 within the LEP.

Warringah and Pittwater Council will mitigate both direct and indirect impacts on the species and consider features that could be incorporated as development controls into the design and implementation of developments that are to be constructed upslope of, or proximate to, the *M. angusii* site. Sufficient vegetated buffers should be retained around the *M. angusii* site to maintain the integrity of its habitat.

Committed agencies 2.3: Warringah Council, Pittwater Council and DoP.

Performance Criterion 2.3: The level of protection afforded to the M. angusii population and habitat is increased through appropriate zoning, conservation planning and land-use decisions.

Action 2.4: Warringah Council will include *M. angusii* in Council's 'operational procedures', which must be followed in threatened species habitat prior to, and during, maintenance activities, to ensure *M. angusii* and its habitat are not impacted.

Committed agencies 2.4: Warringah Council.

Performance Criterion 2.4: M. angusii is included in Council's operational procedures regarding maintenance activities in threatened species habitat.

Objective 3: Conduct research into the genetics, ecology and biology of the species in order to provide information to assist future management decisions

Very little is known about the genetic diversity, biology and ecology of *M. angusii*. As the known population may consist of few or even one genotype, it is a priority in this case to investigate the genetic variation. Knowledge of genetic variation will outline the extent of further research required into aspects such as breeding systems and population dynamics.

If a preliminary genetic study reveals that the known population of *M. angusii* does not show genetic diversity, that is, it consists of one or a few genotypes, then the population is clonal and is not relying on sexual reproduction to survive. Research into the breeding system may therefore be less important than monitoring the known population and determining the appropriate fire regime.

However, if the population is found to be genetically diverse, a program of research on the life history of *M. angusii* and the ability of this population to be self-sustaining in the long term could be more important.

Action 3.1: The Australian National University (ANU), in consultation with DECCW and the recovery team, will undertake a study into the genetic variation of the known population and the genetic relationship between the Ingelside species and other specimens believed to be closely related to *M. angusii*.

Committed agencies 3.1: DECCW.

Potential contributors 3.1: ANU.

Performance Criterion 3.1: Results of the genetic analysis will be available to DECCW in Year 2, Warringah Council and the ANOS Warringah Group.

Action 3.2: DECCW will liaise with tertiary and other research institutions to promote research into the biology and ecology of *M. angusii*.

A program of biological and ecological investigation is required to collect information suitable management on strategies. This program will be co-ordinated and facilitated by DECCW. Research institutions (including the Botanic Gardens Trust within DECCW), universities and native orchid groups will be encouraged to participate in components of this program.

A five-year research program is briefly outlined below. The need for further studies will be evaluated and prioritised after a twoyear program. Using the results of the genetic study, the relative priorities of each element of the research program will be determined.

Fecundity

Monitoring of fecundity will help managers understand the implications of fire regimes and other land management practices on the long-term viability of plants. How many plants set fruit and how much fruit is produced may be directly related to disturbance factors.

Population dynamics

Tagging and monitoring the population will provide some insight into the population dynamics. Data collected will assist in understanding the following aspects of the biology of *M. angusii*:

- how frequently individual plants flower and produce fruit,
- whether recruitment occurs outside of times of disturbance,
- the rate of seedling mortality.

Breeding System

Anecdotal evidence suggests that *M. angusii* may be pollinated by ants (R. Angus, pers. comm.). It is important to know the breeding system employed by a sexually reproducing species for two reasons: it may indicate any problems the population is facing if the pollinator is missing, and it will indicate what management options are appropriate (e.g. if a disturbance is required for the species to reproduce).

The breeding system of *M. angusii* could be researched by field observation and simple experiments using comparisons of successful seed set in bagged flowers (to test self compatibility), flowers whose anthers had been removed (to test for apomixis), and control flowers (flowers left open for pollination from all pollen sources).

Response to fire

Anecdotal evidence suggests that fire may be an important factor in the ecology of M. angusii (R. Angus, pers. comm.). Fire may be a factor that influences flowering and seed production or increased vegetative reproduction. As there is only one small population currently known, a cautious experimental approach to investigate fire response will be used. No trials into fire response will be undertaken until the known population is secure and sufficient knowledge about the structure and stability of the known population has been obtained. When the response to fire of *M. angusii* is known and aspects of the biology are better understood, decisions about fire management can be made.

Committed agencies 3.2: DECCW.

Performance Criterion 3.2: Increased knowledge of the biology and ecology of M. angusii is available for formulation of management strategies for the species, as research is conducted.

Action 3.3: DECCW will reconsider the need for a recommendation of critical habitat under the TSC Act by the final year of implementation of this plan, following a review of new information gained from actions in this plan.

Committed agencies 3.3: DECCW.

Performance Criterion 3.3: Need for recommendation of critical habitat under the TSC Act re-evaluated in year five.

Objective 4: Develop and implement a survey program that will provide information on the extent and viability of *M. angusii* populations and habitat

It is important for the recovery process to determine the full distribution of *M. angusii*. Knowledge of the full distribution and extent of the species will determine the relative importance of the known population and any new populations.

Action 4.1: DECCW will identify and map the location of potential habitat.

Committed agencies 4.1: DECCW.

Performance Criterion 4.1: Potential habitat identified and mapped.

Action 4.2: DECCW, in consultation with the Australasian Native Orchid Society (ANOS) (Warringah Group), will survey potential habitat for undiscovered populations.

It is likely that further populations may occur within the threatened Duffys Forest vegetation community. DECCW will coordinate targeted surveys in potential habitat for the species. Initially a targeted survey for the species will be carried out in the Warringah, Pittwater and Ku-ring-gai areas.

DECCW will seek contributions to fund targeted surveys from Warringah Council and the RTA. This survey effort will be carried out during the flowering season (August–October) over a number of years to attempt to account for temporal changes in the distribution of the species. The initial survey will be integrated with a wider survey of the endangered Duffys Forest vegetation community. Any new population will be confirmed by a specimen collected and forwarded for identification to the Australian National Botanic Gardens. Collection of specimens will be co-ordinated by DECCW.

If the identification of a population is confirmed, DECCW will notify the land manager, and all relevant authorities.

Committed agencies 4.2: DECCW.

Performance Criterion 4.2: Surveys of potential habitat carried out and documented within three years.

Action 4.3: If *M. angusii* is found on private property, Warringah Council, in consultation with DECCW, will facilitate the protection

of *M. angusii* through the implementation of appropriate legislative measures.

If necessary, an appropriate notation will be placed on Warringah Council's section 149 certificates for the parcel of land on which *M. angusii* occurs. As any new populations are located, the Council will amend Section 149 Certificates to indicate the occurrence of the threatened species on the parcel of land and update council GIS information.

Committed agencies 4.3: Warringah Council.

Performance Criterion 4.3: Implementation of appropriate legislative protective measures if M. angusii is found on private land.

Objective 5: Identify and minimise threats to *M. angusii*

Action 5.1: The RTA will ensure that roadworks and road maintenance at the known location at Ingleside, in potential habitat and in any newly discovered sites, will not cause the destruction or degradation of any part of a *M. angusii* population, its habitat or potential habitat.

The RTA will achieve this by: (a) assessing and carrying out all activities with reference to the recovery plan and any future advice regarding the distribution and ecology of *M. angusii*, (b) ensuring that all relevant environmental and site personnel are familiar with the location of known *M. angusii* and potential habitat.

Potential contributors 5.1: RTA.

Performance Criterion 5.1: All activities by the RTA are carried out with reference to the recovery plan and any future advice regarding the distribution, ecology, and potential habitat of M. angusii.

Action 5.2: DECCW and the NSW Rural Fire Service (RFS) will review the conditions for *M. angusii* in the Threatened Species Hazard Reduction List of the Bush Fire Environmental Assessment Code. The most appropriate measures for the protection of *M. angusii* are to be included in relevant Bush Fire Risk Management Plans (pursuant to section 52 of the *Rural Fires Act* 1997). This may be through conservation zoning or other appropriate means by the NSW RFS.

DECCW and RFS will use available biological and ecological information to reassess the immediate and cumulative impact of bush fire hazard reduction works on *M. angusii* and the adequacy of the mitigative conditions in the Threatened Species Hazard Reduction List.

The DECCW representative on the appropriate Bush Fire Management Committee will negotiate the most appropriate measures for the protection of the known and any new populations and potential habitat of *M. angusii*.

Committed agencies 5.2: DECCW and RFS.

Performance Criterion 5.2: Bush Fire Risk Management Plans include the most appropriate measures for the protection of M. angusii, and the mitigative conditions for M. angusii on the Threatened Species Hazard Reduction List reviewed, by year 5 of the implementation of this recovery plan or as relevant information becomes available.

Action 5.3: Until further information becomes available from Action 5.2 the RFS and other authorities will exclude fire during Hazard Reduction activities at known *M. angusii* populations.

Committed agencies 5.3: RFS.

Performance Criterion 5.3: Fire is excluded from known M. angusii populations during Hazard Reduction activities.

Action 5.4: DECCW will prepare site management statements (based on the proforma in Appendix 4) if *M. angusii* is located on DECCW estate, and will

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encourage/liaise with Warringah Council and other landholders to do the same if other populations of the species are located.

DECCW will assess the condition and document the fire and management history of all sites that are located on DECCW estate or on land that becomes subject to a conservation agreement. In each site management statement, DECCW will provide the details of the specific threat abatement measures required and a timetable to implement these measures.

If *M. angusii* is located on other tenures, DECCW will encourage landholders to prepare site management statements for those sites. These statements will detail the specific threat abatement measures required at those sites.

Committed agencies 5.4: DECCW.

Performance Criterion 5.4: Site management statements prepared for any newly discovered sites within three years of the adoption of this recovery plan.

Action 5.5: Warringah Council in consultation with RTA and experts in the field will prepare and implement a site management strategy for the Ingleside population of *M. angusii*.

The site management strategy will provide details of specific threat abatement measures required at the Ingleside site and a timetable to implement these measures. Best available information will be utilised to formulate an approach to slashing at the site and weed monitoring and management. Management actions that have the potential to damage the leaves or flowering stem (such as slashing or the application of herbicide) will not be undertaken during the above ground phase of the species life cycle, ie from April to December.

The strategy will include the implementation of site-awareness and protection procedures for use by contractors when undertaking maintenance at the site. **Committed agencies 5.5:** Warringah Council.

Performance Criterion 5.5: A site management strategy is prepared by Warringah Council and implemented for the Ingleside population of M. angusii..

Objective 6: Raise awareness of the species with public authorities, and provide public authorities with information to assist conservation

Action 6.1: DECCW and Warringah Council will raise the general awareness of the recovery program with the community. This may include general media releases about the *M. angusii* recovery program.

Committed agencies 6.1: DECCW and Warringah Council.

Performance Criterion 6.1: Media releases used to raise community awareness in relation to the recovery program..

Action 6.2: DECCW will update the species profile and environmental impact assessment guidelines, provided in Appendix 3, to incorporate information acquired during the implementation of this recovery plan.

Committed agencies 6.2: DECCW.

Performance Criterion 6.2: Species profile and environmental impact assessment guidelines updated as required and made publicly available.

Action 6.3: All relevant authorities and groups (including Warringah Council, the Warringah Group of the Australasian Native Orchid Society and the RTA) will notify DECCW of any new sites and populations of *M. angusii* located through both targeted survey (e.g. for environmental assessment purposes) and other sightings. DECCW to confirm any possible new populations and incorporate their management into recovery plan activities.

The detection of the species at new sites will enable appropriate environmental assessment to occur and may provide new information relevant to the recovery of the species.

Committed agencies 6.3: DECCW, Pittwater Council, Warringah Council and RFS.

Potential contributors 6.3: RTA and Warringah ANOS.

Performance Criterion 6.3: New information gathered from relevant public authorities and groups sent to DECCW.

Action 6.4: DECCW will ensure that all survey data are collated and sent to the Atlas of NSW Wildlife Co-ordinator for entry into the NSW Wildlife Atlas. All relevant data will then be made available to Warringah Council, the Warringah Pittwater District of the NSW Rural Fire Service and the RTA for use in environmental planning and assessment.

Committed agencies 6.4: DECCW.

Performance Criterion 6.4: All survey data are collated and sent to the Atlas of NSW Wildlife Co-ordinator for entry into the NSW Wildlife Atlas, and made available to stakeholders.

Objective 7: Implement a monitoring program for *M. angusii*

Action 7.1: DECCW will design and facilitate implementation of a monitoring program that will enable long-term monitoring of the population dynamics and viability of *M. angusii* population.

Committed agencies 7.1: DECCW.

Performance Criterion 7.1: A long-term monitoring program to be designed and implemented by year one.

Action 7.2: Warringah Council and the RTA will monitor the population of *M. angusii* at

Ingleside. Warringah Council will develop a procedure to monitor the species (in consultation with DECCW and orchid experts) and assess the impacts of specific management actions, such as weed control and slashing on the population. Warringah Council will provide annual copies of all monitoring reports to DECCW after each flowering season.

Committed agencies 7.2: Warringah Council.

Potential contributors 7.2: RTA.

Performance Criterion 7.2: Population of M. angusii at Ingleside monitored annually for the life of the recovery plan.

Action 7.3: DECCW will use information gained from monitoring and implementation of other actions in this plan to review the recovery plan within five years from adoption as a national recovery plan, and revise the plan if necessary.

Committed agencies 7.3: DECCW.

Performance Criterion 7.3: This recovery plan is reviewed, and revised if required, within five years from adoption as a national plan, to incorporate any new findings for management of the species.

Objective 8: Consideration of the need for *ex situ* conservation

M. angusii is currently known from only one small population so it is important to establish and maintain a store of genetic material ex situ. M.angusii seeds have been collected and stored as part of the Millennium Seedbank Project. These were collected by DECCW (Botanic Gardens Trust) from the population in November 2008 from 10 individuals. This is an possible important safeguard against catastrophe causing extinction of the extant population. The need for a living ex situ population of *M. angusii* will be determined after two seasons when many of the survey, research and management actions have been conducted. This determination will be made by DECCW.

Action 8.1: DECCW (Botanic Gardens Trust) will determine whether a living *ex situ* population of *M. angusii* is required.

Committed agencies 8.1: DECCW.

Performance Criterion 8.1: The need for ex situ conservation of M. angusii is assessed and determined in Year 3.

Action 8.2: DECCW will co-ordinate the establishment and maintenance of *ex situ* collections that fully represent the genetic diversity of the known population, if required.

Committed agencies 8.2: DECCW.

Performance Criterion 8.2: A representative ex situ collection of M. angusii will be established and maintained at a suitable botanic garden, if required.

7 Implementation

A number of agencies are responsible for the management of the known and potential habitat of M. angusii. As the Ingleside population occurs on council-managed land within the Warringah LGA, Council is responsible for management of the population. Also, most of the areas of potential habitat for M. angusii are within Warringah and Pittwater LGAs. These Councils responsible for are the environmental assessment of development that is proposed on private land within their LGA, and developing or modifying Local Environmental Plans.

The RTA is responsible for the management of roadworks and road maintenance within road reserves and easements that may affect the existing populations and potential habitat of *M. angusii*. Appendix 1 outlines the statutory responsibilities of public authorities in relation to threatened species under NSW legislation.

8 Social and economic consequences

8.1 Social considerations

Social issues raised in this recovery plan are: (a) the need for the confidentiality of the exact location of the known site and any new sites to prevent unauthorised collection of individuals of *M. angusii*, and (b) education of the consent and determining authorities of the existence of *M. angusii* and the possibility of further populations occurring on private and public land through the environmental planning process.

As it appears that *M. angusii* is unlikely to be a widespread species, any further populations discovered will be of high conservation significance. Therefore any development that may affect a population of *M. angusii* may require modification to minimise significant effects to that population, and this may have a social consequence in changing development patterns.

8.2 Economic considerations

The economic consequences in this recovery plan are related to the cost of implementing the actions required to protect the species from further decline. The total cost of implementing the recovery actions will be \$114,750 over the five-year period covered by this plan.

As the Ingleside site occurs within an RTA road reserve currently managed by Warringah Council, the primary responsibility for management will be negotiated between the Council and DECCW in co-operation with local bush fire authorities.

The cost for management of the habitat at the Ingleside site will be borne by Warringah Council. Other opportunities for funding may arise from funding grants, enlisting the help of skilled community volunteers, and maintaining an integrated, co-operative approach to survey, fire management and environmental assessment with relevant land managers, the community and Warringah Council.

The wider public in the Warringah Local Government Area may be economically affected due to development constraints imposed as a result of the presence of *M. angusii*, should new populations be found.

9 Biodiversity benefits

It is possible that *M. angusii* plays an important role in the ecological functioning of its habitat.

Conservation of *M. angusii* will mean that this species and its habitat will be available for future scientific studies. Delineation of the preferred habitat of *M. angusii* through targeted survey will benefit the scientific community by increasing knowledge about the species and its habitat. Orchid species are of particular interest to many groups in the community and knowledge gained through the *ex situ* propagation of *M. angusii* will be useful in both the conservation of other threatened taxa and the cultivation of species for horticultural and aesthetic purposes.

The conservation of areas of habitat in which *M. angusii* occurs provides the opportunity to rehabilitate and conserve vegetation in the Duffys Forest Endangered Ecological Community occurring on the lateritic soils of the Ingleside, Duffys Forest, Terry Hills and Belrose areas of northern Sydney.

10 Preparation details

This recovery plan was prepared by Sharon Nash and Tania Duratovic, Senior Threatened Species Officers, DECCW (Metro Branch), in consultation with the *M. angusii* Recovery Team. Lyn Raffan and Natalie Izquierdo (DECCW Threatened Species Officers) made substantial edits to incorporate more recent knowledge in relation to the species. The information in this recovery plan was accurate to the best available knowledge on the date it was approved.

11 Review date

This recovery plan will be reviewed within five years of the date of its adoption as a national recovery plan.

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13 Abbreviations used in this document

ANBG Australian National Botanic Gardens

- ANOS Australian Native Orchid Society
- ANU Australian National University
- AGL Australian Gas Light Company
- **DECCW** Department of Environment, Climate Change and Water (NSW)
- **EP&A Act** NSW Environmental Planning and Assessment Act 1979
- **EPBC Act** Commonwealth Environment Protection and Biodiversity Conservation Act 1999
- **LEP** Local Environmental Plan
- **LGA** Local Government Area
- **NPW Act** NSW National Parks and Wildlife Act 1974
- NPWS NSW National Parks and Wildlife Service within DECCW
- **NV Act** NSW Native Vegetation Act 2003
- **PVP** Property Vegetation Plans
- **RFS** Rural Fire Service
- **RTA** Roads and Traffic Authority
- **TSC Act** NSW Threatened Species Conservation Act 1995

Action	Description	Responsible party	Priority	Fund	Cost estimate (\$'s/year)					Total
no.			^	source	Year 1	Year 2	Year 3	Year 4	Year 5	cost (\$)
1.1	Co-ordinate recovery program	DECCW	1	In kind [*]	8,340	8,340	8,340	8,340	8,340	41,700
2.1	Legislatively protect the known population	DECCW	2	In kind*	500	500	500	500	500	2,500
2.2	Location record keeping	Warringah Council	1	Core	-	-	-	-	-	-
2.3	Review and preparation of EPIs	DoP/Warringah Council	1	Core	-	-	-	-	-	-
2.4	Include in operational procedures	Warringah Council	1	Core	-	-	-	-	-	-
3.1	Genetics study	ANU	2	To be identified						
3.2	Promote research	DECCW	2	In kind [*]	500	500	500	500	500	2,500
3.3	Review need for TSC Act critical habitat	DECCW	2	In kind [*]	0	0	1000	0	0	1,000
4.1	ID and map potential habitat	DECCW	2	To be identified	4,170	0	0	0	0	4,170
4.2	Census known population	DECCW/ANOS	1	To be identified	8,340	0	0	0	0	8,340

Table 2. Estimated costs of implementing the actions identified in the recovery plan

Action	Description	Responsible party	Priority Fund	Cost estimate (\$'s/year)					Total	
no.			^	source"	Year 1	Year 2	Year 3	Year 4	Year 5	cost (\$)
4.3	Protection of <i>M. angusii</i> on private land – if required	Warringah Council	2	In kind*						
5.1	RTA to minimise threats	RTA	1	Core	-	-	-	-	-	-
5.2	Fire protection	DECCW/RFS	1	DECCW core	0	0	0	8,340	0	8,340
5.3	Fire exclusion	RFS	1	Core	-	-	-	-	-	-
5.4	Develop site management statements for new populations - if required	DECCW	2	To be identified	0	0	0	4,170	4,170	8,340
5.5	Develop and implement site management strategy for known population	Warringah Council	1	In kind*	8,340	0	0	0	0	8,340
6.1	Raising awareness of <i>M.</i> angusii	DECCW /Warringah Council	3	In kind*	500	500	500	500	500	2,500
6.2	Update sp. & environmental impact assessment guidelines	DECCW	2	In kind*	0	0	1,000	0	0	1,000
6.3	Notification of, and confirm any new populations of <i>M. angusii</i>	DECCW/Warringah Council/Pittwater Council/RFS/ANOS/ RTA	2	Core	-	-	-	-	-	-
6.4	Update NSW Atlas	DECCW	2	In kind*	0	500	0	500	0	1,000
7.1	Develop monitoring program	DECCW	3	To be identified						

Action	Description	Responsible party	Priority Fund		arty Priority Fund Cost estimate (\$'s/year)						Total
no.			^	source"	Year 1	Year 2	Year 3	Year 4	Year 5	cost (\$)	
7.2	Develop monitoring procedure and monitor known population	Warringah Council/RTA	1	Warringah Council/ RTA							
7.3	Review plan	DECCW	2	In kind [*]	0	0	0	0	4,170	4,170	
8.1	<i>Ex situ</i> conservation	DECCW	2	To be identified	0	0	4,170	0	0	4,170	
8.2	Implementation of <i>ex situ</i> program – if required	DECCW	2	To be identified	0	0	0	8,340	8,340	16,680	
Total	Annual cost of M. angusii				30,690	10,340	16,010	31,190	26,520	114,750	
DECCW - ANBG Au *In-kind F ^Priority r *Core repr	DECCW – Department of Environment, Climate Change and Water; DoP – Department of Planning; ANU – Australian National University; ANOS – Australian Native Orchid Society; ANBG Australian National Botanic Garden; RTA – Roads and Traffic Authority; RFS – Rural Fire Service. *In-kind Funds represent salary component of permanent staff and current resources. ^Priority ratings are: 1 - action critical to meeting plan objectives, 2 - action contributing to meeting plan objectives, 3 - desirable but not essential action at this time. #Core represents where no costing is provided as the action is a core activity of the organisation/s involved.										

Public authority	Relevant responsibilities
Department of Environment, Climate	• Assessment of section 91 licence applications under the TSC Act.
Change and Water	 Assessment of section 132C licence applications (e.g. for bushland regeneration activities) under the NPW Act.
	Assessment of proposed activities on DECCW estate.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
	• Advice to consent and determining authorities, with a possible concurrence role under the EP&A Act.
	• Preparation of priority action statements and co-ordination of implementation.
	• Preparation of plans of management for DECCW estate.
Relevant local governments	 Preparation of local environmental plans (LEPs) under Part 3 of EP&A Act. Consultation with DECCW is required if the LEP will or may affect threatened species, populations, communities or their habitats.
	 Assessment of development applications under Part 4 of EP&A Act.
	• Assessment of council works under Part 5 of EP&A Act.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
	Consideration of conditions in Threatened Species Hazard Reduction List when issuing Bush Fire Hazard Reduction Certificates under <i>Rural Fires Act 199.7</i>
	• Plans of management for community land must be prepared or amended to take into account council's obligations under a recovery plan.
Department of Planning	• Development of policy and strategies, including State Environmental Planning Policies, for land use planning and environmental assessment.
	 Assessment of major development applications under Part 3A of the EP&A Act.
	 Determination of certain development proposals under Part 4 of the EP&A Act.
	• Approval of certain activities under Part 5 of EP&A Act.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
Department of Lands	• Environmental protection principles must be observed in

Appendix 1: Public authority responsibilities

Public authority	Relevant responsibilities
	relation to management of Crown land.
	• Plans of management may be prepared for Crown land.
	 Approval of activities on Crown land under Part 5 of EP&A Act.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
Rural Fire Service	 Consideration of impacts on threatened species, populations, communities and their habitats when exercising functions and when preparing Bush Fire Risk Management Plans and Plans of Operations.
	• Approval authority for works under Part 5 of EP& A Act.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
	 Consideration of conditions in Threatened Species Hazard Reduction List when issuing Bush Fire Hazard Reduction Certificates.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.
Roads and Traffic Authority and other public authorities (eg Dept of Education and Training, RailCorp, Dept of Commerce)	• Appropriate management of public lands with known or potential habitat.
	• Approval authorities for activities under Part 5 of EP&A Act.
	 Consideration of objectives and actions of a recovery plan when undertaking assessment of significance under section 5A of EP& A Act.

Appendix 2: Additional *M. angusii* information

Relationship to other legislation

Additional legislation relevant to the conservation and recovery of *M. angusii* in NSW includes the following:

- Environmental Planning and Assessment Act 1979,
- National Parks and Wildlife Act 1974,
- Local Government Act 1993,
- Native Vegetation Act 2003,
- Rural Fires Act 1997,
- Rural Fires and Environmental Assessment Legislation Amendment Act 2002.

The most significant implications of the above legislation with regard to M. angusii are described below, and the major existing obligations of public authorities in relation to M. angusii are outlined in Appendix 1.

Environmental Planning & Assessment Act 1979

Consent and determining authorities are required to consider potential impacts on *M. angusii* and its habitat when considering development or activity proposals under parts 4 and 5 of the EP&A Act.

Part 3 of the EP&A Act provides for the preparation of environmental planning instruments (EPIs) and this presents opportunities to conserve important habitat for *M. angusii* at the landscape level. For example, important sites that contain *M. angusii* can be protected under an appropriate environmental zoning when councils prepare or review local environment plans. This is a more effective means of providing for the conservation requirements of a species than through the assessment of individual development applications.

Native Vegetation Act 2003

The NV Act establishes a framework for the management of native vegetation in NSW and makes provision for the preparation of property vegetation plans (PVPs). A PVP is a voluntary but legally binding agreement between a landholder and a Catchment Management Authority that clarifies what can be done with native vegetation on a property for the period of the plan (up to 15 years).

Under recent changes to the TSC Act, the Minister for the Environment has conferred biodiversity certification on the native vegetation reforms package (of which the NV Act is a component). As such, landholders will not need to apply for a separate licence to 'harm' or 'pick' a threatened species, or damage its habitat, if an activity is undertaken in accordance with an approved PVP.

Rural Fires Act 1997

The *Rural Fires Act 1997* (RF Act) requires all parties involved in fire suppression and prevention to adhere to the principles of ecologically sustainable development when exercising their functions and when preparing plans of operation or Bush Fire Risk Management Plans. Consideration must be given to the impact on threatened species and their habitats.

Under the RF Act, certain public authorities can authorise bush fire hazard reduction work (including prescribed burning and mechanical vegetation clearance) in habitat for a threatened species by issuing a Bush Fire Hazard Reduction Certificate (BFHRC). These certificates can only be issued for works that comply with the Bush Fire Environmental Assessment Code (BFEAC), and occur on land that is subject to a Bush Fire Risk Management Plan. The Threatened Species Hazard Reduction List forms part of the BFEAC and contains specific conditions for sites that support threatened species.

Where proposed bush fire hazard reduction activities do not meet the criteria necessary to allow a BFHRC to be issued, then an approval under Parts 4 or 5 of the EP&A Act, or s91 of the TSC Act is required.

National Parks & Wildlife Act 1974

A scientific licence may be issued under Section 132C of the NP&W Act to 'pick' *M. angusii* or damage its habitat for scientific, educational or conservation purposes. For example, restoration works in the habitat of *M. angusii* will require a s132C licence if no other approvals are required under the EP&A Act.

Local Government Act 1993

The LG Act defines the powers, duties and functions of all local councils in NSW. Section 8(1) of the Act requires councils to properly manage, develop, protect, restore, enhance and conserve the environment of the area for which it is responsible, in a manner that is consistent with, and promotes the principles of, sustainable development. This includes the integration of biodiversity considerations into the decision-making process.

Chapter 6 of the Act requires councils to prepare plans of management for community land that take into account councils' obligations under approved recovery plans.

Scientific description

The following description is adapted from Jones (1996): M. angusii grows 25-60 cm tall with green, linear terete (cylindrical and tapering) leaves that are 40-140 cm long and 4-8 mm wide. The leaves are usually much longer than the flowering stem, which emerges from the leaf about 12-20 cm above the soil. The flowering stem bears 20-60 small green flowers in a dense raceme 8–18 cm long. Each flower is about 2.5 mm in diameter and is apiculate (bears a short, sharp but soft point), and cucullate (hood shaped). The flower is made up of two whorled sections, one within the other. The outer whorl contains the dorsal (top) and two lateral (side) sepals. The dorsal sepal is ovate and the lateral sepals are narrowly lanceolate and recurved (curved upwards). Inside the sepals are a pair of petals and the labellum (the third unpaired petal). Each of the petals is linear to linear-lanceolate, is incurved and partly enclosed in the dorsal sepal. The labellum is the key feature that most distinguishes M. angusii from the other Microtis species that occur in the same area. The labellum is oblong-ovate and decurved (curves downward) and has a notch at the apex. The margins of the bottom two thirds of the labellum have irregular papillose excrescences. There are two thickened structures on the labellum called calli. The column (the central body consisting of the fused stamens and styles) is 2 mm long and 1.5 mm wide. The stigma is 0.8 mm wide and square. The anthers are apiculate and approximately 0.8 mm wide. The pollinarium consists of four yellow mealy pollinia and is approximately 1.5 mm long. The fruit is an ellipsoid capsule, 5–6 mm long and 3.5–4 mm wide. The vegetative and floral parts of *M. angusii* are illustrated in Figure 3.



a: plant, b: flower from front, c: flower from side, d: labellum from above, flattened out e: longitudinal section of labellum, f: column from front, g: column from side, h: pollinarium, i: dorsal sepal, j: petal, k: lateral sepal.

Figure 3. Microtis angusii, Ingleside. D. L. Jones.

Taxonomic hierarchy:

Order:	Asparagales
Family:	Orchidaceae
Subfamily	Orchidoideae
Tribe:	Diurideae
Subtribe:	Prasophyllinae
Genus:	Microtis
Species:	angusii
Author:	David L. Jones
Date:	September 1996

Distribution

Collection history

M. angusii was first collected and proposed as a new species by Mr Reginald Angus in 1987 (R. Angus, pers. comm.). It was named and described by David Jones in 1996 (Jones 1996). In 1983, an individual *Microtis*, possibly *M. angusii* was sighted at Bantry Bay Oval at Seaforth, about 10 km from the known location, but no collection was made and the record has never been confirmed (R. Angus, pers. comm.).

A collection of what was believed to be *M. angusii* was made from Sunny Corner State Forest, near Bathurst, 100 km west of Sydney in 1998 (J. Riley, pers. comm.). These specimens were confirmed as *M. angusii* (D. Jones, pers. comm.). The National Parks and Wildlife Service (now part of DECCW), however, visited the *Microtis* site at Sunny Corner on 22 October 1999 and five

samples of what was believed to be *M. angusii* were collected for use in genetic analysis. A preliminary genetic analysis of this material has been completed. The results of the genetic testing indicate that the Sunny Corner specimens are genetically distinct from the Sydney population, which represents the type locality for the species (Peakall 2001; 2002).

Specimens of *Microtis* that were thought to be *M. angusii* were also collected at Chain Valley Bay near Wyong (about 90 km north of Sydney) in August 1999. These were sent to the Australian National Botanic Garden, Canberra for identification by David Jones (J. Riley, pers. comm.), who confirmed it as being a different species of *Microtis*.

Biology

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). Pollination of *M. parviflora* by small ants of the genus *Iridomyrmex* has been documented in Victoria (Jones 1975), and flightless worker ants of the species complex *Iridomyrmex gracilis* have been shown to be effective pollinators of *M. parviflora* in Castlereagh State Forest near Sydney (Peakall and Beattie 1989). The ants carry the pollinia cemented on their frons (head segment) by the viscidium. Bates (1981) observed tiny male wasps of the family Ichneumonidae and male and female orange wasps of the family Brachonidae, transferring pollen from one flowering spike to another in a hybrid swarm of *Microtis* in South Australia. The pollinia were attached to the head of the wasps. No pollinators have been observed for *M. angusii* to date (R. Angus, pers. comm.).

Hybridisation occurs between species of *Microtis*. In some areas species complexes or hybrid swarms occur in areas where *M. rara*, *M. unifolia* and *M. parviflora* co-exist (Bates 1981).

Many species of *Microtis* are self compatible and a high level of self-fertilisation and inbreeding within populations can occur. In *M. parviflora* it was found that 40% of the flower visits by ants occurred within the same inflorescence, promoting self-pollination. Self-pollination accounted for 51% of the total pollen transfer (Peakall and Beattie 1989).

Autogamy

Many species of *Microtis* are autogamous and if insects do not pollinate the flowers they will self-pollinate (Bates 1986). This ensures that all flowers set seed, even in the absence of a pollinator. Bates (1981) reports that on examination of thousands of plants of most *Microtis* species, all plants examined had set seed. In *M. angusii* almost all inflorescences examined have set seed over the last two seasons (R. Angus, pers. comm.). The indication is that *M. angusii* may be self-compatible and autogamous. Field observations and trials are required to test this theory.

The ability to self-pollinate (autogamy) may be an advantage in species that sustain a history of population bottlenecks or pollinator failures (Lande and Schemske, quoted in Peakall and Beattie 1991), and in colonising species that may establish populations from one individual. As Peakall and Beattie (1991) state, "The widespread distribution of *Microtis* species together with its apparent colonising ability may be the result of ant-mediated pollination and the exploitation of a ubiquitous pollinator".

Apomixis

Flowers have been observed to set seed even when the pollinia have been dislodged by insects and no contact has been made with the stigma. This process of apomixis or asexual production of seed as been reported for many *Microtis* species (Bates 1986).

Appendix 3:*M. angusii* Species Profile & Environmental ImpactAssessment Guidelines

The information provided in the species profile and the environmental impact assessment guidelines is the best available at the time of publication of this recovery plan. They will be updated periodically as new information becomes available. Consent and determining authorities, developers and EIA consultants should ensure that they obtain the most recent information by contacting the Biodiversity Conservation Section of the relevant region of the Department of Environment, Climate Change and Water.

THREATENED SPECIES INFORMATION

Microtis angusii

Common name: Angus's Onion Orchid

Family: Orchidaceae

Conservation status

Microtis angusii is listed as endangered on Schedule 1 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and endangered under the Commonwealth Environment Protection and Biodiversity *Conservation Act 1999* (EPBC Act).



Photo: Reg Angus

Description

The genus *Microtis* consists of over 20 named species distributed mostly over the

temperate parts of Australia with three species occurring in the eastern tropics (P. Eygelshoven, pers. comm.; Dockrill 1992). The genus is named after the small ear like lobes or auricles on each side of the anther 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).

Four named species of Microtis are known to occur in the Warringah-Pittwater area, M. parviflora, M. unifolia, M. rara and M. angusii. Two species, M. parviflora and M. unifolia, are relatively common and widespread, they are similar in appearance and can be confused with each other. M. rara can be identified by its larger labellum and tendency to flower in the season following a bushfire (P. Eygelshoven, pers. comm.). M. angusii is distinguished in the field by its more robust habit and larger size and, on closer examination, by floral characteristics. However, it is possible that the species has been misidentified in the past and more populations may exist.

Distribution

M. angusii is endemic to New South Wales and is currently only known from its type locality at Ingleside in the north of the Sydney metropolitan area.

Recorded occurrences in conservation reserves

M. angusii has not been recorded from conservation reserves.

Habitat

It is not easy to define the preferred natural habitat of *M. angusii* as the Ingleside location is a highly disturbed site. At Ingleside, the dominant species occurring on the site are the introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. In the past the site has been used as a soil depot and a vehicle parking site. It has been cleared of its original native vegetation. One dead native tree exists on site. This is possibly a *Eucalyptus sieberi*.

The population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest, Terrey Hills, Ingleside and Belrose areas. These soils support a specific vegetation type distinct from that occurring on the surrounding Hawkesbury Sandstone soils. This vegetation type, the Duffys Forest Vegetation Community, is listed as an endangered ecological community under the TSC Act and ranges from open forest to low open forest and rarely woodland. Eucalyptus sieberi, E. gummifera, E. haemastoma with E. capitellata or E. globoidea are the species. dominant canopy Angophora costata is also found at a few localities. It is possible that *M. angusii* may be found in other locations that support this vegetation community (Smith and Smith 1997). Further surveys are expected to assist in understanding the fine scale distribution of the species.

Ecology

Most *Microtis* species, including *M. angusii*, exist as subterranean tubers during most of the year. *M. angusii* produces leaves and then flowering stems in late winter and spring, and flowers from May to October (Jones 1996). In *Microtis*, the flowers mature from the bottom of the inflorescence to the top. The capsules at the bottom of the raceme may have already released their seed before the flowers at the top have opened (Bates 1986). *M. angusii* produces numerous ellipsoid fruits, which dehisce and presumably distribute seed. By summer the above-ground parts have withered leaving no parts above ground.

Threats

Inappropriate fire regime

As the known site of *M. angusii* occurs along a major road, there is great potential for the population to be adversely affected by an inappropriate fire regime. The most likely scenario is too-frequent fire caused by arson, hazard reduction activities and accidental sparking (e.g. from cigarettes).

Habitat degradation related to unrestricted access

Uncontrolled site access has led to rubbish dumping, soil compaction and soil dumping, which have led to habitat degradation. The site has been used as a fill dump and has been disturbed during the construction of a nearby sewerage pipe. A small fence was then erected to keep vehicles and equipment off the site. This has stopped vehicles from driving into the site but does not preclude people or a vehicle at high speed entering the site.

Weed invasion

Weed invasion is symptomatic of degraded habitat. Weeds can out-compete native species, particularly in the understorey, and eventually change the nature and function of that habitat to the detriment of the native species that occur there. The weed species of concern at the Ingleside site are *Acacia saligna* and Coolatai grass (*Hyparrhenia hirta*). Any removal of weeds near *M*. *angusii* plants should take into consideration the possible effects of herbicides on the plant and the timing of any works.

Unauthorised collection

As a rare orchid, *M. angusii* is a possible target for unscrupulous amateur orchid enthusiasts and professional orchid

propagators. It is an offence under the TSC Act to pick an endangered plant species without a licence from DECCW. No level of unauthorised collection could be sustained by the population at this stage.

Grazing

Plants at the known site have at times been grazed almost to ground level. It was thought that this was the result of rabbit and goat grazing. If grazing continues, the population may fail to flower and set seed in future seasons. The long-term effect of grazing may be detrimental to the population.

Management

Management of *M. angusii* should attempt to:

- increase our current understanding of the species' biology and ecology,
- reduce threats and reasons for decline, and
- increase social and economic factors that may influence the success or otherwise of the recovery plan.

Recovery plans

A draft recovery plan has been prepared for *M. angusii*.

For further information contact

Biodiversity Conservation Section, Metropolitan Branch, Environment Protection and Regulation Division, Department of Environment and Climate Change, PO Box 1967, Hurstville NSW 2220. Telephone: 02 9585 6678.

Internet: <u>www.environment.nsw.gov.au</u>

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ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES

Microtis angusii

Common name: **Angus's onion orchid** Family: **Orchidaceae**

The following information is provided to assist authors of Species Impact Statements, development and activity proponents, and determining and consent authorities, who are required to prepare or review assessments of likely impacts on threatened species provisions pursuant to the of the Environmental Planning and Assessment Act 1979. These guidelines should be read in conjunction with DECCW's Threatened *Biodiversity* Survey and Assessment: Guidelines for Developments and Activities (DEC 2006a).

Survey

Survey for *Microtis angusii* should be undertaken between August and October when the orchid is in flower. The species would be difficult to identify in the absence of flowers.

It is not easy to define the preferred natural habitat of *M. angusii* as the Ingleside location is a highly disturbed site. At Ingleside, the dominant species occurring on the site are the introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. In the past the site has been used as a soil depot and a vehicle parking site. It has been cleared of its original native vegetation. One dead native tree exists on site. This is possibly a *Eucalyptus sieberi*.

The population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest, Terrey Hills, Ingleside and Belrose areas. These soils support a specific vegetation type distinct from that occurring on the surrounding Hawkesbury Sandstone soils. This vegetation type, the Duffys Forest Vegetation Community, is listed as an endangered ecological community under the TSC Act and ranges from open forest to low open forest and rarely woodland. Eucalyptus sieberi, E. gummifera, E. haemastoma with E. capitellata or E. globoidea are the dominant canopy species. Angophora costata is also found at a few localities. It is possible that M. angusii may be found in other locations which support this vegetation community (Smith and Smith 1997). Further surveys are expected to assist in understanding the fine scale distribution of the species.

There may be a need for targeted survey for the species when assessing the impact of a development, including survey within potential habitat of *M. angusii* where the species is currently unrecorded. Features to mitigate both direct and indirect impacts on the species, if found, could be incorporated into the design and control of developments that are to be constructed upslope of, or proximate to, M. angusii sites. Sufficient vegetated buffers should be retained around sites containing M. angusii to maintain the integrity of its habitat. The extent and design of the buffers required to achieve this will be site-specific, depending on factors such as aspect and slope, drainage patterns and adjacent land uses.

Where new sites are located, site details including plant numbers, habitat and location should be recorded and forwarded to the DECCW.

Life cycle of the species

The ecology of *M. angusii* is described in the draft recovery plan (DEC 2006) and summarised in the species profile.

Proposals that are likely to impact upon the life cycle of the species include those that contribute to the following:

Loss of individuals

The significance of a particular activity that physically destroys individual plants will require an examination of the number of plants to be destroyed in relation to the size of the population and a discussion of how recruitment, gene flow and the overall health of the population will be affected. Translocation should not be considered as an appropriate means of compensating for the loss of individuals due to the uncertainty associated with the long-term survival of translocated plants.

Loss and fragmentation of habitat

As the breeding system of *M. angusii* is not well understood, the effects of loss and fragmentation of its habitat are not known. Destruction of habitat may place a local population at risk of extinction.

Altered fire regimes

The response of adult plants of the species to fire is uncertain. As the known site of *M*. *angusii* occurs along a major road, there is great potential for the population to be adversely affected by an inappropriate fire regime. The most likely scenario is toofrequent fire caused by arson, hazard reduction activities and accidental sparking (e.g. from cigarettes).

Modification of habitat

Development in close proximity to the *M*. *angusii* site is likely to cause modification of habitat through altered hydrological conditions, changes in soil pH and nutrient levels, weed invasion, potential introduction of plant pathogens and altered fire frequency. Subsequent increases in pedestrian and/or vehicular traffic through sites may result in trampling, soil compaction, soil erosion and rubbish dumping. Other proposals that result in grazing, slashing, spraying or burning of *M*. *angusii* habitat are also likely to result in the modification of that habitat.

Threatening processes

Competition and grazing by the feral European rabbit is a key threatening process listed under both the TSC and EPBC Act and is relevant to *M. angusii*. The invasion of native plant communities by exotic perennial grasses is also listed as a key threatening process under the TSC Act and is impacting on the species at Ingleside.

Other threatening processes relevant to this species include slashing and herbicide spraying to maintain road verges, weed invasion, illegal collection of the species and rubbish dumping (including construction materials).

Viable local population of the species

The viable population size for *M. angusii* is unknown. In the absence of a detailed assessment demonstrating otherwise, all populations should be assumed to be viable.

A significant area of habitat

Assessment of habitat significance for *M. angusii* requires consideration of the following:

- number of *M. angusii* plants present (including consideration of the soil seed bank),
- proportion of the local population present,
- location in relation to the current known distribution of the species,
- size, condition and connective importance of the habitat,
- uniqueness of habitat and

• management potential including the likelihood of ameliorating any existing threatening processes.

DECCW considers that any known viable population of *M. angusii* occupies a significant area of habitat until such time as adequate and representative examples are conserved.

Isolation/fragmentation

As the species is only known from one population, fragmentation of the site may have a detrimental effect on the population. The known population is extremely vulnerable to threats and *M. angusii* is inadequately reserved. The population is small and its long-term viability is unknown.

For further information contact

Biodiversity Conservation Section, Metropolitan Branch, Environment Protection and Regulation Division, Department of Environment and Climate Change, PO Box 1967, Hurstville NSW 2220. Telephone: 02 9585 6678. Internet: <u>www.environment.nsw.gov.au</u>

OReferences

NSW Department of Environment and Conservation (2006). *Microtis angusii* Draft Recovery Plan. NSW Department of Environment and Conservation, Hurstville NSW.

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Regional distribution of the habitat

M. angusii is endemic to New South Wales and is currently only known from its type locality at Ingleside in the north of the Sydney metropolitan area.

Adequacy of representation in conservation reserves or other similar protected areas

M. angusii is not represented in formal conservation reserves.

Critical habitat

Critical habitat has not been declared for *M*. *angusii*.

Appendix 4:Site management statement pro forma

Site Management Statement		
Prepared by:		
Date:		
Site details:		
Site Name:		
Site Code:		
Location:		
Easting:AMG Zone:		
Land owner/Land manager contact details		
Name:		
Phone number:		
Postal address:		
Parcel details:		
LGA:		
Portion/Lot:		
Street address:		
Zoning:		
Tenure:		
Current landuse:		

I opulation accump

No. adults: Count: [] Estimate: [] Lowest estimate =Best estimate =Upper estimate =
No. seedlings: Count: [] Estimate: [] Lowest estimate =Best estimate =Upper estimate =
Area of Occupancy:Accurate: [] Estimate: []
Detailed site map attached: Yes/No
Reproduction: Buds: [] Flowers: [] Fruit: []
Habitat:
Dominant Associated species:
Threats:

Predominant weed species and abundance:
Previous management actions (describe apparent success):
Threat abatement actions required:

Recommended monitoring and evaluation program:.