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Eucalyptus parvula L.Johnson & K. Hill (Myrtaceae)

Review of Current Information in NSW

June 2008

Current status:

Eucalyptus parvula is currently listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The NSW Scientific Committee recently determined that *Eucalyptus parvula* meets criteria for listing as Endangered in NSW under the *Threatened Species Conservation Act* 1995 (TSC Act), based on information contained in this report and other information available for the species.

Species description:

Eucalyptus parvula is described in Brooker *et al.* (2000) as follows: "Tree to 10 m tall. Bark smooth throughout or with some persistent rough, grey bark on lower trunk; smooth bark predominantly dark grey, at times with ribbons of decorticated bark in the upper branches. Juvenile stem rounded in cross-section; juvenile leaves opposite for many pairs, sessile, elliptical to ovate or lanceolate, 1.6-4cm long, 0.9-1.3cm wide, green. Crown characteristically retains large numbers of juvenile leaves, with some petiolate, lanceolate intermediate and adult leaves. Crown leaves opposite or alternate, petiole 0-0.3cm long, elliptical to lanceolate, 3-8cm long, 0.5-1.5cm wide, base tapering to petiole, concolorous, dull, green, penniveined, moderately reticulate, intramarginal vein parallel to and just within margin, oil glands mostly island. Inflorescences axillary unbranched, peduncles 0.3-0.7cm long, 7-flowered; buds sessile, ovoid to clavate, smooth or slightly warty, scar present, operculum conical to rounded, stamens irregularly flexed or inflexed, anthers cuboid to globoid, versatile, slits separate, style short, stigma blunt, locules 3 or 4, the placentae each with 4 vertical ovule rows; flowers white. Fruit sessile, cup-shaped, 0.4-0.5cm wide, disc raised-convex or annular to level or descending, valves 3 or 4, near rim level. Seed dark brown, 1-1.5 mm long, ovoid or depressed-ovoid, often lacunose, dorsal surface smooth, hilum ventral."

The notes accompanying numerous herbarium records describe it as a small tree or mallee, and it seems likely that the mallee form develops after death of the original trunk due to fire, drought or age. Like the co-occurring *Eucalyptus pauciflora* (Snow Gum) and *E. stellulata* (Black Sally) it appears to resprout primarily from basal buds rather than along the branches (expert advice). This is typical of eucalypts growing in moist and not very fire-prone habitats.

Taxonomy:

The species was originally described as *Eucalyptus parvifolia* (Cambage 1909) and re-named *Eucalyptus parvula* by Hill & Johnson (1991), as the first name had previously been applied to a

NSW SCIENTIFIC COMMITTEE

fossil eucalypt. They consider it to be most closely related to the very rare *Eucalyptus recurva*, endemic to the Braidwood area, a short distance north of the range of *E. parvula*.

Distribution and number of populations:

Records of *Eucalyptus parvula* were gathered from the DECC Wildlife Atlas, the Australian National Herbarium and the DECC YETI vegetation survey database. After deletion of obvious duplicate records the total number of records assessed is 89. This may still include some duplicates collected at the same place on the same date but lodged at different herbaria, and with slightly different information on the herbarium labels.

Herbarium records range from 1908 to 2002, and the locality details in many of the earlier records are vague (e.g. "Umeralla district", "Kybeyan"). Those in the DECC Wildlife Atlas have by necessity been converted to a dot on a map, which may be a very inaccurate representation of the original location of the collection. Location details of more recent records, if based on vague locality details (e.g. "Nunnock Swamp"), may be no more accurate.

The majority of records of *Eucalyptus parvula* were found to come from four locations along the edge of the coastal escarpment:

- the Badja Mill area, 70 km south of Braidwood (10 collections);
- the Two Rivers Plain area on the upper Tuross River about 25 km to the south (at least 21 collections), with another three records from Duck Hole Creek c. 4 km SW from Two Rivers Plain in the Tuross River headwaters ;
- the Kybeyan River and its tributary Mowitts Swamp Creek, another 10 km south (numerous old records from "Kybeyan", and some old and recent records from Mowitts Swamp Creek);
- Dragon Swamp on New Line Road, north of Cathcart, some 42 km south of Kybeyan (five Atlas records, two identical YETI records), with one record from "Nunnock Swamp" (Moran 1983), very close by and part of the same drainage system.

There is one 1949 record from slightly further south that states: "1 km NE of Cathcart". Another record from 1981, "24 km NNE of Bombala", probably refers to the known Dragon Swamp location on New Line Road, as the straight-line distance is correct for this location. As Cathcart is located on Dragon Swamp Creek, plants collected in 1949 may be (or may have been if not still present) outliers of, or continuous with, the New Line Road population.

Duck Hole Creek and Mowitts Swamp Creek, while on separate drainage systems (with Mowitts Swamp Creek draining ultimately west into the Numeralla River), are separated by a single low ridge and by less than 500 m at their closest point. Suitable habitat for *Eucalyptus parvula* is

NSW SCIENTIFIC COMMITTEE

almost continuous between the two catchments and it seems likely that records from these two upper catchments sample a single subpopulation.

Outlying records:

A small number of additional records come from Steeple Flat Road (also referred to as Old Bega, Brown Mountain Road, and Rockleigh in herbarium and YETI records), c. 8 km east of Nimmitabel, on an upper branch of Scotts Creek which flows ultimately to the Numeralla River.

There is a single herbarium record from 2002 from flats east of the Numeralla River on the western side of the Kybeyan Range, and well west of most records of the species. This record has no description of the locality or associated vegetation, and the grid reference provided is located on a low ridge above the Numeralla River flats. This represents a more elevated position than the species might be expected to occur on and requires confirmation.

Another record within the Kybeyan Range from 1962 probably involves a mistake with the locality details. The recorded detail “3.2 km W of Kybeyan Trig” places the record in steep dry country in the Kybeyan Range, however if the location were 3.2 km west of Kydra Trig, which is located on the edge of the coastal escarpment about 17 km south-east of Kybeyan Trig, then this record would be in the Mowitts Swamp Creek area where there are several other records including one from 2004.

Another isolated record (from the YETI database) is in a travelling stock reserve 2 km west of Countegany on the Numeralla Road on Undoo Creek, a tributary of the Big Badja River. The location is plausible and this record is most likely correct. Nothing is known, however, of the population size or area of occupancy at this location.

There are two outlying sites on the YETI database which are returned when a search is performed for *E. parvula*. These are two sites located on the Braidwood to Nerriga road. When the species lists for these survey quadrats are consulted, *E. parvula* is not present. Recorded eucalypts include *E. aggregata*, *E. ovata*, *E. viminalis* and *E. pauciflora*. The sites may appear because they are linked to a general species list for the vegetation formation Montane Bogs and Fens which is located on this database, and which includes *E. parvula*.

Another record on the YETI database which is well outside the known range of the species is from “Gurnang State Forest, near Gingkin Farm access” in the Central Tablelands botanical division. No further information about the location of this record was obtained. The species list for the quadrat does include *E. parvula* and the elevation of 1 270 m is plausible for the occurrence of this species. However, the site is categorised as being a hill crest, and the floristic data includes *E. fastigata* (with a cover-abundance score of 3) and *E. radiata* (cover-abundance score of 4), which seems extremely unlikely as a location for *E. parvula*. This species invariably occurs on montane swamp margins or fringing grassland in association with *E. pauciflora* and *E. stellulata*. This record is likely to be a transcription error. Another definite transcription error is the coastal quadrat in Goura Nature Reserve south of Narooma.

NSW SCIENTIFIC COMMITTEE

Of particular interest are two outlying records in the Tinderry Range north of Cooma. One record from 1963 in the Wildlife Atlas is from “Tinderry Creek 15 km NE of Michelago”. The site description is “Along creek in flat country at c. 850 m elevation. Small smooth-barked tree.” The second record was obtained from the Australian National Herbarium database, but does not appear on the Wildlife Atlas. The species was collected at “Lyons Creek Farm, Tinderry Road (no date), with additional notes “Grassy slope with *E. rubida*, peppermint, *E. pauciflora*. Tree 5 m tall, bark thick, rough over whole trunk, crown juvenile, green, glossy.” The records are close, but not in exactly the same location. These two records raise the possibility of another sub-population of *E. parvula* located some 55 km NNW of the Big Badja River area. While the Tinderry Range consists primarily of steep granitic ranges with deeply incised rocky river valleys, it does include some small areas of moist flats around the headwaters of creeks which could be suitable habitat for *E. parvula* (expert advice).

It should be noted that *E. parvula* has been brought into cultivation and could be planted in locations similar to its natural habitat, giving rise to apparently natural populations. The 1963 record from the Tinderry Range, however, seems early for this to have happened.

Ecology:

Key habitat requirements

In its main areas of occurrence *Eucalyptus parvula* grows in grassy woodland around the edges of broad, flat upper drainage lines along the edge of the coastal escarpment. It may also occupy similar habitat in the Tinderry Range, about 25 km further inland. Many herbarium label details state that it occurs in association with *E. pauciflora* (Snow Gum) and *E. stellulata* (Black Sally). Co-occurrences of *E. viminalis*, *E. ovata* and *E. rubida* are also occasionally recorded, although the latter is quite likely to be a misidentification of *E. dalrympleana*. Soils in such areas are likely to be poorly-drained loam derived from granite or granodiorite with high humus content, possibly approaching peat in the lower lying areas.

Prober *et al.* (1990) are of the opinion that the majority of the former grassy flats habitat of this species has been cleared, relegating most remaining populations to more marginal habitat around the edges of such flats, where they may have less of a competitive advantage over other eucalypt species. They may also be more inclined to hybridise in such situations where they are in closer contact with other eucalypts such as *E. viminalis* or *E. rubida*.

Life history

Little is known about the reproduction biology of this species however it is likely to be similar to other congeners. It might be expected that pollination would be by a range of generalist nectar and pollen feeding invertebrates including bees, beetles, flies and moths, as well as feral honey bees (**Apis mellifera*). Flowering is likely to be sporadic rather than regular, and possibly stimulated by adverse environmental conditions such as drought (large flowering events immediately after droughts are common among local eucalypts). In most eucalypts seed is stored

NSW SCIENTIFIC COMMITTEE

on the plant to be released principally after death of the branch or the plant, with most recruitment occurring after disturbance. Seed dispersal distances are likely to be less than 50 m except in strong winds. The viability period for seed in the soil is likely to be relatively short. The net effect of these factors would be to reinforce population fragmentation, both natural and that induced by clearing, since i) pollinators are not known to include highly mobile species such as fruit bats or birds, ii) flowering is not likely to be highly synchronised within or between subpopulations, and iii) seed dispersal ability is low. Plants are likely to be long-lived (50 to 100 years or more) and to take at least several years to reach reproductive maturity.

Recruitment events appear to be uncommon (expert advice) and are likely to be episodic following disturbance, as with many other eucalypts. Populations in relatively undisturbed situations such as at Dragon Swamp and Mowitts Swamp Creek include relatively few young (i.e. small) plants (expert advice), although Prober *et al.* (1990) found that plants carrying fruit generally constituted a small proportion of the population. Judging by the fairly uniform size of the majority of trees at Dragon Swamp/New Line Road, this would be because flowering and fruit set are infrequent and erratic rather than because the bulk of the population is immature.

Multi-stemmed plants are not uncommon at Dragon Swamp and Nunnock Swamp, and probably represent coppice regrowth after fire since trees in nearby forest show ample evidence of a past intense fire. A single stem resprouting from an old lignotuber with a single fallen dead trunk occurs on the roadside on Steeple Flat Road. As the plants are clearly capable of resprouting from the base, a shortage of seedling recruits may not constitute a threat to the medium term viability of the population.

It may be a lack of suitable disturbance events that has caused the apparent shortage of young plants in relatively undisturbed sites, although in grazed sites browsing pressure from livestock is also likely to be contributing. On New Line Road the only area where young plants are conspicuous is in the grader mound of loose soil on the edges of the road. Unfortunately most of these new plants have to be lopped to keep the road open. On Two Rivers Plain an episode of tree clearing has reportedly been followed by copious regeneration (expert advice).

In the more or less permanently moist soils of escarpment wet grassland the grass cover is typically quite dense, and exposure of mineral earth is likely to be a very infrequent event. Droughts would be unlikely to create bare ground as they frequently do in a drier climate and vegetation type, so that recruitment events may be limited to immediately after fires or artificial disturbance such as that created on road edges.

Population size:

The current best estimates of population size for each of the known extant populations are presented in Table 1. The only systematic survey of *Eucalyptus parvula* was documented by Prober *et al.* (1990) and the field work was undertaken in 1988 (expert advice). These authors described eight populations but counted the Two Rivers Plain area as three separate populations.

NSW SCIENTIFIC COMMITTEE

At the time of their survey, these populations were the total known occurrence of the species. Very few of the herbarium records provided on the DECC Wildlife Atlas make any reference to the number of plants present.

Table 1: Summary of current knowledge on populations of *Eucalyptus parvula*

| Location | *Population Count (fruiting individuals) | Current best population estimate | Assumptions |
|-----------------------------|--|----------------------------------|--|
| Badja | 424 (269) | 424 | |
| Two Rivers Plain | 2 407 (800) | c. 2 407 | No net change despite clearing and recruitment |
| Undoo Creek | - | 10 | Assume small outlying population away from main habitat on upper drainage lines. |
| Duck Hole Creek | - | 200 | Population size is an inference based on the number of plants recorded over 2 km. |
| Mowitts Swamp | 72 (15) | 400 | Best guess based on counts from Atlas record (2004), Prober <i>et al.</i> (1990) and expert advice. |
| Rockleigh (Steeple Flat Rd) | 42 (14) | 42 | The difference between the estimate of 42 plants and a recent count of 23 plants is due to plants distant from the road being overlooked, not losses (expert advice). |
| Nunnock Swamp | c. 300 (60) | 475 | The same two subpopulations were counted by Prober <i>et al.</i> (1990) and in 2008 (expert advice). Numbers were very hard to determine in this area as the majority of plants are post-fire multi-stemmed regrowth |
| Dragon Swamp | c. 270 (54) | 340-390+ | Based on rough counts in May 2008 (expert advice) |
| TOTAL | c. 3515 (1212) | c. 4300-4350+ | |

* Prober *et al.* (1990) data

NSW SCIENTIFIC COMMITTEE

The total population at Two Rivers Plain numbered 2 407 plants in 1988 but there has been some clearing on the property, including the larger part of the population (expert advice). This clearing occurred about 12 years ago (i.e. c. 1995-1996) and regeneration in the cleared area has apparently been abundant, including a large number of young *E. parvula*. The status of this portion of the population has not been reassessed but it is believed that the population has not been reduced by the clearing event (expert advice).

Prober *et al.* (1990) did not record the population on Duck Hole Creek on the upper Tuross catchment. This might be assumed to be of a reasonable size as *E. parvula* was recorded in 2002 in or near three quadrats distributed over 2 km of creek frontage. On one herbarium record sheet it is recorded as “dominant”, and on another as “infrequent patches on rocky rises”.

In Nunnock Swamp only five definite, isolated seedling recruits were seen (as opposed to probable coppice growth). These seedlings were about 1 m high and located within the swamp, close to existing swamp margin patches of *E. parvula* i.e. in wetter habitat than the bulk of the population occupies. They may have germinated during the drought of 2002-2006 when bare ground was exposed in what would normally be small pools.

Data are still required on: i) the size of the population on Undoo Creek west of Countegany, ii) whether occurrences remain further south than Dragon Swamp/New Line Road, and iii) what the extent of any occurrence(s) in the Tinderry Range or on the Numeralla River west of Kybeyan Range might be. There are other swamps along the escarpment which represent suitable habitat, and the extent to which these have been surveyed in the past survey is unknown. However, all of Packers Swamp, most of Bega Swamp, most of Nunnock Swamp and parts of many other smaller swamp patches from Badja State Forest in the north to the upper reaches of Badgerys Creek on Tantawangalo Mountain Road in the south, have been searched and have not recorded *E. parvula* in any other locations. There are however extensive areas of potential habitat on private property to the west of the areas surveyed, most of which are within national parks. No population occurs on Dragon Swamp proper, which is located about 4 km downstream from the New Line Road population recorded as “Dragon Swamp” (expert advice). Dragon Swamp proper extends over 4.5 km along Dragon Swamp Creek, mostly on private property, so it may not have been searched exhaustively. It seems the likeliest location for the 1949 collection.

Threats:

The majority of occurrences of the species are on private property, in an area used primarily for cattle grazing on native pastures, however some populations are reserved. The Nunnock Swamp and known Dragon Swamp populations which were in the former Nunnock Swamp Flora Reserve within Tantawangalo State Forest are now more secure within the Tantawangalo Section of South East Forest National Park. The lower parts of Dragon Swamp are partially in Tantawangalo State Forest but mostly on private property. A small proportion of the Mowitts Swamp Creek population is within the recently extended boundary of Wadbilliga National Park. A 2005 survey along the new park boundary, incorporating a formerly grazed but forested leasehold area,

NSW SCIENTIFIC COMMITTEE

recorded 80 plants inside the park boundary, with approximately 70 more visible close by on private property to the west. The 100 plants recorded in 1989 on Mowitts Swamp Creek as being just outside the park boundary are also now within the park. However, the bulk of the suitable habitat within this area is on private property, and it is unlikely that many more plants than have already been detected occur in the park, the boundary of which runs along the upper edge of suitable habitat.

It appears that none of the records in the Badja area are within Badja Swamp Nature Reserve (which contains extensive suitable habitat), although some may be close to its southern boundary considering the doubtful accuracy of grid references derived from old herbarium records. Searches around this swamp in two areas closer to the northern end did not locate the species (expert advice). Records in the Wildlife Atlas in the Two Rivers Plain area include one for which the grid reference is well within Wadbilliga National Park. However, it seems likely that this is an error, since the record is a long way east of the main distribution, in steep country. The Yowrie 1:25 000 topographic map shows the presence of some potential habitat inside the park boundary on tributaries of Back River and the Tuross River. A survey of one such swamp north of Kydra Fire Trail did not locate the species, but the extent to which other such habitat within the park has been searched is unknown (expert advice).

Prober *et al.* (1990) consider that the relatively high genetic diversity demonstrated by *E. parvula* (similar to that of common and widespread species such as *E. saligna*) suggests that the currently fragmented population was better connected until recently. The flats on which the species occurs are quite valuable for grazing and could have been utilised with only minor clearing (compared with adjacent taller, denser forests) so it is likely that these areas were cleared early in European settlement of the area (circa 1850?). Such flats are extensive along the upper ends of both east and west draining river systems along the coastal escarpment, and in many places the upper ends of adjacent catchments are separated by only a narrow sliver of forest. The total population of *E. parvula* could once perhaps have been almost continuous throughout the area between Badja and Cathcart, and possibly slightly further to the south. The relatively high genetic diversity found by Prober *et al.* (1990) in material collected in 1988 suggests that the effect of population fragmentation has not begun to be seen yet, but genetic divergence between populations which appear to now be separated by substantial gaps could be expected to occur. This could ultimately result in reduced viability of subpopulations.

More immediate threats could include the following:

Clearing

There has already been one relatively recent (c.1995-96) episode of clearing at Two Rivers Plain, but it seems that the cleared stand has replaced itself or even increased in numbers as a result of prolific subsequent regeneration (expert advice). Of course, had the area been heavily grazed after clearing the outcome is likely to have been very different, so the effect of clearing would not always be so benign. The advent of the *Native Vegetation Act 2003* should put a stop to events

NSW SCIENTIFIC COMMITTEE

such as this although given that much of the potential habitat is out of sight of public roads, there is no guarantee that legal sanctions against clearing will be 100% effective. As most subpopulations are on private property the majority of the population is vulnerable to this threat. 'Clearing of native vegetation' is listed as a Key Threatening Process under the TSC Act in NSW.

Lack of regeneration

Grazing and trampling by livestock is well known to inhibit recruitment among trees and shrubs growing in situations where pressure from livestock is more or less continuous. Occasional breaks in grazing, if timed to coincide with the presence of suitable conditions such as the breaking of a drought, can allow a cohort of seedlings to become established, so recruitment can sometimes occur in grazed areas. It was notable at Mowitts Swamp Creek that the only young plants detected were on the National Park side of the boundary fence (expert advice), suggesting that lack of regeneration is a greater threat to populations on private property than those in reserves.

Sites within reserves are not immune from the effects of grazing pressure. Feral pigs and deer are well established along the coastal escarpment top. Rooting by pigs and browsing or rubbing by deer could destroy young plants, although no evidence of this was observed at Dragon Swamp. A deer was seen at the site however, and damage to grassland by pigs is very extensive around the *E. parvula* population in this location. Conversely, pig rooting among the grass and baring of mineral earth could provide a suitable seedbed for recruitment to occur, although this is purely speculative. The Nunnock Swamp population shows much less evidence of pig presence and deer scat is sparse in this area. The two areas are only 500 m apart though and feral animals are likely to move between them.

The fact that the only locations where extensive recruitment has occurred in recent years have been where there has been ground disturbance suggests that a policy of excluding all disturbance from *E. parvula* stands would be misguided. 'Herbivory and environmental degradation caused by feral deer' and 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa*' are listed as Key Threatening Processes under the TSC Act in NSW.

Seed collection

Eucalyptus parvula is grown in the domestic nursery trade as a small eucalypt suitable for the home garden, and is also grown overseas to provide foliage for the cut flower industry (McCarthy *et al.* 2007). Localised pressure from seed collectors has been recorded in the Two Rivers Plain area, which, although on private property, is accessible due to the network of tracks through the area which provide public access to Wadbilliga National Park. As this population numbered more than 2 000 plants at last count and is distributed over quite a wide area, it is unlikely that such collection would affect more than a few of the most accessible trees. At Dragon Swamp there are several trees close to New Line Road carrying fruit (expert advice), so it appears that

NSW SCIENTIFIC COMMITTEE

this highly accessible population is not targeted by collectors. The longer the species is in cultivation the more likely it becomes that seed will be collected from cultivated rather than wild plants. Hence, seed collection appears to be a minor or negligible threat at present.

Soil pathogens

The introduction of *Phytophthora cinnamomi* or other soil-borne pathogens is always possible where there are roads running through or close to populations. Evidence of *Phytophthora* presence has already been found at the old Cattleman's Track crossing point of Nunnock Swamp, c. 3 km upstream of the Nunnock Swamp *E. parvula* population (expert advice). The Two Rivers Plain area is criss-crossed by tracks leading into Wadbilliga National Park which serve recreational park users as well as residents of the area. There are also plants adjacent to the main Kybeyan-Countegany Road in this area. Similarly the Badja population is in an area with numerous private property tracks.

The sensitivity of *E. parvula* to *P. cinnamomi* is not known. Many eucalypts seem relatively resistant, but some, such as *E. imlayensis*, appear to have been killed by the pathogen. 'Infection of native plants by *Phytophthora cinnamomi*' is listed as a Key Threatening Process under the TSC Act in NSW.

Weed invasion

Invasion by exotic plants is unlikely to be a significant threat to *Eucalyptus parvula*. While grassland around the plants may include a significant proportion of exotic grasses such as **Anthoxanthum odoratum* (Sweet Vernal Grass) or **Holcus lanatus* (Yorkshire Fog), this is unlikely to affect adult plants, or prove any more of an impediment to recruitment than the normally dense cover of native grasses found in its habitat, such as *Poa labillardierei*, *Poa sieberiana*, *Austrofestuca hookeri*, *Rytidosperma nudiflorum* and *Hemarthria uncinata*. Most populations are remote from gardens so environmental weeds typical of cooler climates such as **Crataegus monogyna* (Hawthorn) are unlikely to become significant, although Hawthorn occurs in one of Crawford's quadrats at Duck Hole Creek. One plant was noted at Dragon Swamp with an individual of **Rubus ulmifolius* (Blackberry) growing at its base. No other Blackberry infestations were seen in association with plants. The fact that most populations are in grazed situations may, paradoxically, reduce the weed threat, at least for woody weeds.

Climate change

It might be expected that as an occupant of low-lying parts of the landscape in a relatively high rainfall area *E. parvula* would be intolerant of drought, but this does appear to always be the case. There have been instances of cultivated trees of the species grown in dry situations on the coast dying back to the base in the severe drought of 2002-2003, though one subsequently produced a basal shoot. At Dragon Swamp and Steeple Flat Road two populations visited after the prolonged drought between 2002 and 2006 contained many plants exhibiting signs of dieback amongst the outer branches. A single plant on which all the old stems had died was observed to be

NSW SCIENTIFIC COMMITTEE

resprouting from the base. At the Nunnock Swamp population, which appears to be in a wetter area than the Dragon Swamp population, very few instances of branch dieback were seen, although there were a few small plants which had died back to the base. The species is sensitive to drought, but the prolonged and severe 2002-2006 drought did not produce significant tree kills (as it did for several other eucalypt species in south coast forests). Nor does drought appear to have stimulated recruitment, as it has recently in many other eucalypt species in the region.

An increase in drought frequency or intensity within the species' range, as currently predicted under climate change, could reduce the population viability in the long term. It could also increase the amount of time when the escarpment swamps are dry and thus subject to invasion by seedlings of other tree species from the surrounding forest or woodland, decreasing the competitive advantage of *E. parvula* within its habitat. It is already apparent at Dragon Swamp that *E. pauciflora* and *E. stellulata* have produced considerably more seedlings than *E. parvula* in the past few years.

An increase in fire frequency might increase opportunities for recruitment, and fires are not very likely to become so frequent that young plants are killed before reaching reproductive age. Fires within *E. parvula* habitat are likely to be very infrequent events currently. Fire is not very likely to become a significant factor in plants which are scattered in pasture on private property, but may be more significant in reserved populations which are surrounded by, or on the edge of, large expanses of forest.

Given that the habitat of this species is located in the coldest, wettest part of the landscape within its range, under conditions of increased average temperatures and possibly lower effective rainfall, it may find itself with nowhere to retreat to. Climate change could therefore represent a significant threat in the long term. 'Anthropogenic Climate Change' is listed as a Key Threatening Process under the TSC Act in NSW.

Hybridisation

Prober *et al.* (1990) record the presence of hybrids and feel this could present a problem for the long term survival of *E. parvula*. They state: "The differential removal of *E. parvifolia* from sites where it best outcompetes other eucalypts...may be a more immediate problem for the conservation and survival of the species. Remaining trees are restricted to the margins of these populations where they are currently, and perhaps always have been, introgressing with *E. viminalis* and perhaps *E. rubida*." Potts & Jackson (1986) observed a similar problem in some isolated populations of Tasmanian eucalypts. They suggested that although hybridisation may not be important at the boundary of large stands, it may have important evolutionary consequences in small peripheral isolates. These stands may contract to the point where selection is unable to counter-balance pollen swamping from more abundant surrounding species, and may eventually result in phantom hybrid populations. Hence, removal of the nucleus of *E. parvifolia* populations and the lack of regeneration in core habitat areas converted for pasture, may jeopardise the ability

NSW SCIENTIFIC COMMITTEE

of *E. parvifolia* to maintain its genetic integrity and compete successfully in more marginal habitat.

No hybrids have been observed in the Dragon Swamp population (where a specimen was collected and determined as *E. parvula x viminalis* in 1986) or the Nunnock Swamp population.

Extreme population fluctuations:

Eucalyptus parvula is a long lived plant and is not subject to extreme fluctuations in population size.

Population reduction and continuing declines:

A significant historical reduction in population numbers may be inferred from the present apparently fragmented distribution of *Eucalyptus parvula* contrasted with its high level of genetic diversity and low level of genetic divergence between subpopulations to date (Prober *et al.* 1990). The trees are likely to be long-lived and the period since the main clearing event (probably c.150-180 years) may well represent less than three generations. There are insufficient data to enable an assessment of whether there has been a recent decline in numbers. A clearing event at Two Rivers Plain has reportedly not resulted in a long term decrease in numbers as the loss has been made up by subsequent prolific regeneration (expert advice). Counts in 2008 from Dragon Swamp and Nunnock Swamp are larger than the 1988 counts of Prober *et al.* (1990) but as both counts are rough, and may not have applied to exactly the same area, this is no indication of an actual change in numbers (expert advice). Similarly, lower counts in the Steeple Flat Road area (23 vs. 42) may not have been of the total population in this area. This assessment has not included accurate counts in any other areas. The existence of a current continuing decline cannot be confirmed at this point, although a projected decline could be inferred, largely due to climate change and barriers to recruitment.

Extent of Occurrence (EOO) & Area of Occupancy (AOO):

If the Tinderry Range occurrence and the record west of the Kybeyan Range from 2000, both of which require further assessment, are excluded then the EOO consists of a narrow strip about 76 km long by 6 km wide at most, or 456 km². If the Tinderry Range occurrence can be confirmed as a natural population, this would extend the EOO very substantially (pushing the width of the strip to 25 km rather than 6 km).

Analysing AOO in terms of 2 x 2 km grid squares (the spatial scale of assessment recommended by IUCN 2008), and again ignoring the two most westerly recorded locations, the lowest AOO is 10 of these grid squares (i.e. 40 km²) and the highest is 16 (i.e. 64 km²). Including the Tinderry Range and Numeralla River records would only increase these figures by one such grid square for each location.

NSW SCIENTIFIC COMMITTEE

While the AOO is small in aggregate and in each subpopulation, the likelihood of the larger subpopulations being eliminated by a stochastic event appears low. Plants are usually widely scattered within each subpopulation (expert advice), reducing the likelihood that a single event could eliminate all individuals. However, smaller subpopulations such as that on Steeple Flat Road could decline to extinction fairly readily through lack of recruitment. The species appears relatively robust to disturbance, and indeed lack of disturbance may represent a greater threat in the long term, since some form of disturbance may be essential for recruitment.

Severe fragmentation:

The population is assumed to have been fragmented by clearing for grazing (Prober *et al.* 1990), though it would have formerly been somewhat fragmented by the requirement for a specific habitat which occurs largely on upper drainage lines. On the basis of currently known populations it is reasonable to say that the population is severely fragmented. Were one subpopulation to be removed or decline to extinction, it is very unlikely that recolonisation of that area would occur from remaining subpopulations, given: i) the distances (between 4 and 42 km) that separate currently known subpopulations, ii) the matrix of unsuitable habitat in which small pockets of currently suitable habitat are embedded, and iii) the poor dispersal ability of the species. It is likely that subpopulations are reproductively isolated, assuming that pollination is effected by insects with a limited range, rather than by more mobile animals such as flying foxes or honeyeaters. This is probably a valid assumption given that the escarpment is unlikely to be a major migration route for either group of animals.

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NSW SCIENTIFIC COMMITTEE

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Explanatory note

Between 2007 and 2009 the NSW Scientific Committee undertook a systematic review of the conservation status of a selection of plant and animal species listed under the Threatened Species Conservation Act. This species summary report provides a review of the information gathered on this species at the time the Review was undertaken.

The Scientific Committee's report on the Review of Schedules project and final determinations relating to species that were either delisted or had a change in conservation status can be found on the following website: www.environment.nsw.gov.au .

The Committee gratefully acknowledges the past and present Committee members and project officers who ably assisted the Committee in undertaking the Review of Schedules Project. Information on the people involved in the project can be found in the Acknowledgement section of the project report entitled "Review of the Schedules of the Threatened Species Conservation Act 1995. A summary report on the review of selected species" which is available on the abovementioned website.

This species summary report may be cited as:

NSW Scientific Committee (2008) *Eucalyptus parvula*. Review of current information in NSW. June 2008. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. NSW Scientific Committee, Hurstville.