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Additions and amendments to the rare or threatened vascular plants of Wollemi National Park, central eastern New South Wales

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Abstract: A review and update to the list of significant vascular plant taxa has been made for the c. 500 000 ha Wollemi National Park, approximately 100 km north-west of Sydney, New South Wales. A previous assessment in 2008 revealed the presence of 94 significant taxa, including 15 listed as Endangered and 22 listed as Vulnerable in NSW Threatened Species legislation. New field surveys, coupled with analysis of observation (NSW OEH Bionet Atlas) and specimen collection (Australasian Virtual Herbarium) databases, has added a further 16 significant taxa to the reserve total, elevating it to 110. A revised assessment of the total threatened flora, as listed on the NSW *Biodiversity Conservation Act 2016*, shows there to be 1 Critically Endangered, 19 Endangered, 26 Vulnerable taxa and 2 Endangered Populations. For Commonwealth listed taxa under the *Environment Protection and Biodiversity Conservation Act 1999*, there are 1 Critically Endangered, 9 Endangered and 23 Vulnerable taxa. Sixty-one taxa are currently unrepresented within either legislation and may be considered rare, 8 taxa remain scientifically undescribed (one addition in this revision, *Pultenaea 'monticola'* Mt Irvine), while updated names are provided for two taxa now formally described (*Eucalyptus expressa* and *Prostanthera stenophylla*).

Following assessment of all newly added taxa against IUCN criteria, one currently unlisted species (*Hibbertia coloensis*) qualifies as Critically Endangered, while a second (*Bertya linearifolia*) qualifies as Endangered. Discussion is also provided on six taxa where database records show them to be present within Wollemi, but are here excluded following closer examination.

Keywords: Significant, threatened, rare, Wollemi National Park, IUCN

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Introduction

Wollemi National Park (c. 32° 20' – 33° 30'S, 150° – 151°E) lies approximately 100 km north-west of Sydney, and conserves large areas of dissected sandstone country extending north from the adjoining Blue Mountains National Park to Goulburn River National Park in the Hunter Valley, east to Yengo National Park and Parr State Conservation Area, and west to the settlements of Bylong, Rylstone and Lithgow (Fig. 1). It forms a significant component (49%) of the Greater Blue Mountains World Heritage Area, inscribed in the year 2000 and encompassing seven other adjoining conservation reserves (Blue Mountains, Gardens of Stone, Kanangra-Boyd, Nattai, Thirlmere Lakes and Yengo National Parks, and Jenolan Karst Conservation Reserve).

A previous paper (Bell 2008) outlined 94 significant plant taxa known from the 501 900 ha Wollemi National Park ('Wollemi'), and over the intervening ten years additional survey and database reviews have uncovered new populations of important species. It is now timely to update the list and conservation status of significant plant species present within the reserve. In 2008, 15 of the 94 significant taxa were listed as Endangered, while 22 were Vulnerable. With this revision, a further 16 taxa have been added to the list of significant species, raising the total to 110. Brief outlines for each of these follows. Readers are referred to Bell (2008) for information on climate, geology and soils present within Wollemi.

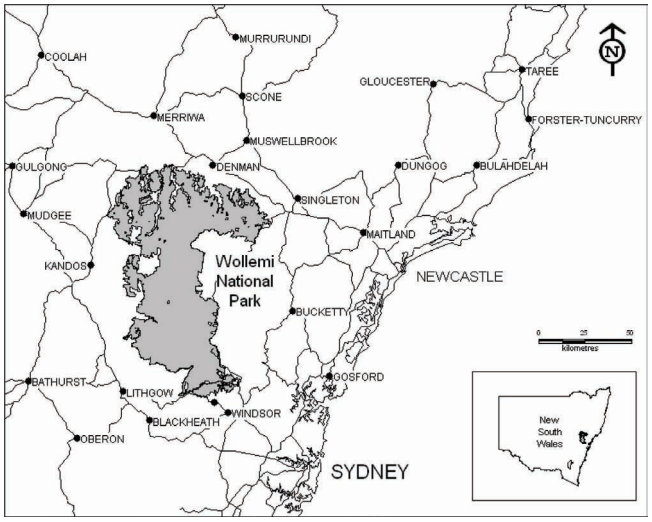

Fig 1. Location of Wollemi National Park, central eastern New South Wales.

Methods

Data obtained through various general and targeted field surveys form the basis of the updated information presented in this paper, undertaken between the years 2008 and 2017. These new surveys were not always designed to specifically uncover significant plant species but aimed to sample all taxa within the different habitats and vegetation communities present. Voucher specimens for all new populations of significant species have been lodged at the National Herbarium of New South Wales (NSW). In addition, a review of the Bionet Atlas database (NSW Office of Environment and Heritage, accessed December 2018 to January 2019) and the Australasian Virtual Herbarium (Council of Heads of Australasian Herbaria, accessed December 2018 to January 2019) was made to collate new collections and observations lodged since 2008. The list of other significant species known from areas adjacent to Wollemi shown in Bell (2008) were a particular focus, but otherwise all significant taxa with records falling within Wollemi were assessed for positional accuracy and independent corroboration prior to acceptance. In some cases, information held in published or unpublished papers, databases or reports was sought to validate additional taxa.

Earlier documentation of significant Wollemi species applied International Union for the Conservation of Nature (IUCN) conservation risk codes to all 94 taxa based on IUCN (2001). New Wollemi taxa have been similarly assessed but using the more recent IUCN (2017) guidelines. To facilitate this, a cleaned dataset (duplicates removed, outliers scrutinized) of all AVH and Bionet Atlas records were combined with personal undatabased observations to allow assessment of Extent of Occurrence (EOO) and Area of Occupation (AOO) for each taxon. The Geospatial Conservation Assessment Tool (GeoCAT: http://geocat.kew.org) was used to calculate EOO and AOO, and allocation was made to the relevant threat category using these figures in concert with IUCN guidelines. The recommended cell width of 2 km was adopted for AOO in all cases, and all available records (NSW and beyond) were utilised. The total number of records included for each assessment of geographical range are indicated in the *n* value cited with resultant EOO and AOO figures.

Throughout this paper, reference to observations included in the NSW OEH Bionet Atlas database use the term 'Bionet Atlas', while collections from the Australasian Virtual Herbarium use the acronym 'AVH'. In general, specimen collections take precedence over observational records given the existence of voucher material that may be reviewed. Specimen collections discussed are identified by their herbarium catalogue number, name of the collector and date of collection, while observation records from the Bionet Atlas include sighting identifier codes. Listing within State or Commonwealth legislation is shown as the *BC Act 2016* (NSW *Biodiversity Conservation Act 2016*) and the *EPBC Act 1999* (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).

New additions

1. Bertya linearifolia *Halford & R.J.F.Hend. (Euphorbiaceae)*

Note was made in Bell (2008) of the collection of Type material for *Bertya linearifolia* from northern Wollemi, yet an assessment of its conservation significance was not made. This species remains unlisted on NSW and Commonwealth legislation, but remains a poorly collected entity which is

evidently very rare. When describing the taxon, Halford and Henderson (2002a) cite only the Type (NSW 216894, C. Gibson & R. Miller, July 1988) and one other specimen (NSW 194999, C.F. Laseron, July 1924). Since 1988 only a further three specimens have been lodged at herbaria, with one additional observation record (SPJGI3995795) also present in the Bionet Atlas. The last of these falls within Wollemi in the Widden Valley, and was made in open forest of *Eucalyptus fibrosa* and *Callitris gracilis* subsp. *gracilis*, with *Phebalium squamulosum* var. *gracile*, *Leucopogon muticus* and *Lepidosperma laterale*. An additional collection has also been made adjacent to the reserve near Bylong (NSW 892903, S.A.J. Bell, July 2013), suggesting that other plants may be present within much of northern Wollemi however none have surfaced during two decades of survey there. *Bertya linearifolia* consequently remains a very rare and very poorly collected taxon. An EOO of 616 km^2 and an AOO of 24 km^2 (n = 6) have been calculated for this taxon.

2. Commersonia rosea *S.A.J.Bell & L.M.Copel. (Malvaceae)*

A wildfire event in northern Wollemi during mid-October 2013 stimulated the germination and growth of *Commersonia rosea* (Fig. 2) across many tens of hectares, comprising tens of thousands of plants (Bell & Holzinger 2015). This species was previously confined to a small number of locations within and adjacent to Goulburn River National Park, and the new Wollemi population represents the largest yet known. At this new location, occupied habitat was predominantly level or near level sandstone rock platforms and ridgelines, often with stunted mallee-like trees of *Eucalyptus dealbata*, and in several places co-occurred with the endangered *Monotaxis macrophylla*. *Commersonia rosea* is currently listed on both the *BC Act 2016* and *EPBC Act 1999* as Endangered. An EOO of 883 km^2 and an AOO of 44 km^2 (n = 25) have been calculated for this taxon.

3. Cymbidium canaliculatum *R.Br. (Orchidaceae)*

The Hunter catchment population of the epiphytic orchid *Cymbidium canaliculatum* (Fig. 3) is listed as an Endangered Population under the *BC Act 2016*. While this species can be locally common in grassy forests and woodlands of the Hunter Valley floor and foot slopes, it is rare in the elevated landscapes that comprise Wollemi National Park. Three recent records, however, made within the last decade indicate that the species does occur here. A Bionet Atlas observation (SPJGI4517263) made in February 2011 shows *Cymbidium canaliculatum* to be present within Wollemi in the Doyles Creek valley c. 10 km south-west of Jerrys Plains, although there are no notes on host or associated species. Two observations were later made by the author in a broad valley in the Glen Gallic area of the reserve in November 2014, c. 13 km south of Martindale, each of a single individual in a fork of a mature *Eucalyptus moluccana*. Based on this, and observations made in the Bylong Valley adjacent to the north-western corner of Wollemi (Bell & Driscoll 2014), there are likely to be further individuals of *Cymbidium canaliculatum* across the northern footslopes of the reserve. An EOO of 12,486 km^2 and an AOO of 400 km^2 (n = 224) have been calculated for this taxon within the Hunter catchment, although this species also occurs extensively elsewhere in New South Wales, Queensland, the Northern Territory and Western Australia.

Fig 2. *Commersonia rosea* flowering and fruiting in northern Wollemi, October 2014.

Fig 3. *Cymbidium canaliculatum* flowering near northern Wollemi, November 2008.

4. Dillwynia tenuifolia *DC. (Fabaceae, Faboideae)*

Dillwynia tenuifolia (Fig. 4), listed as Vulnerable on the *BC Act 2016*, is historically recognised as a species of the Cumberland Plain and associated shale ridges occurring at low elevation in that vicinity (James et al 1999; Rymer et al 2002; Fairley 2004). Ongoing survey in southern Wollemi has uncovered several populations of this species which have extended the known range into the Wollemi Creek and Putty districts, both within Wollemi and on adjacent private lands. The long-standing disjunct records of this species at Darkey Creek (NSW 393370, C.E.B.H. Burgess, January 1962) and at Milbrodale (Maryott-Brown & Wilks 1993) are now not so remote from proximate populations. Collections near Wollemi Creek (NSW 897213, S.A.J. Bell, June 2008; NSW 973926, S.A.J. Bell, September 2008) describe habitat as open forest of *Eucalyptus fibrosa* on gravelly soils (where it was abundant), and in some cases on rocky sandstone ridgelines (considerably less abundant). Further north near Putty, *Dillwynia tenuifolia* occurs in open forest of

Eucalyptus prominula, Angophora costata and *Eucalyptus punctata* (NSW 975443, S.A.J. Bell, May 2012) and open forest of *Eucalyptus crebra* and *Eucalyptus sparsifolia* (NSW 975440, S.A.J. Bell, May 2011). Other collections shown in AVH have been incorrectly positioned, with some (such as NE 45333, J.B. Williams, November 1974) from the Mellong area of Wollemi inconsistent with the written description ("*c. 15 km SSW of Windsor, near Castlereagh*"). An EOO of 10,713 km^2 and an AOO of 560 km^2 (n = 1,924) have been calculated for this taxon. Significant outliers in the Kanangra-Boyd (NSW 465622, I. Crawford, June 1998), Belanglo (CANB 321056.1, P. Snowdon, 1964) and Murrumbidgee River (NSW 458292, I. Crawford, September 1995) areas have been omitted from this assessment pending confirmation.

5. Eucalyptus fracta *K.D.Hill (Myrtaceae)*

Collections of a small ironbark made along the Glen Gallic Trail of northern Wollemi in 2012 were determined initially as *Eucalyptus fracta* (Fig. 5), although there remains some uncertainty with this identification. *Eucalyptus fracta* principally occurs at the eastern end of the Broken Back Range near Pokolbin (Hill 1997; Copeland & Hunter 2005), some 65 km to the south-east of Glen Gallic. In the field the small stature, bare upper branches and fruit morphology were sufficiently consistent with known populations of *Eucalyptus fracta* along the Broken Back Range to support the initial diagnosis, but since that time there has been no advancement in identity. This collection (NSW 984037, S.A.J. Bell, June 2012) is currently housed in AVH as an indeterminate *Eucalyptus* taxon, and re-inspection of this population is warranted. The nearest confirmed collection of *Eucalyptus fracta* lies c. 40 km to the south-east of Glen Gallic (and approximately mid-way to the Broken Back Range population), along the northern escarpment of Yengo National Park near Milbrodale (NSW 862264, S.A.J. Bell, June 2006), suggesting that outliers such as at Glen Gallic are not unusual. Until such time that the Glen Gallic population can be re-assessed, *Eucalyptus fracta* (listed as Vulnerable on the *BC Act 2016*) is here considered a tentative addition to the Wollemi flora. An EOO of 176 km^2 and an AOO of 44 km^2 (n = 35) have been calculated for this taxon.

Fig 4. *Dillwynia tenuifolia* flowering in western Sydney, November 2004.

Fig 5. *Eucalyptus fracta* flowering on the Broken Back Range, December 2004.

6. Eucalyptus michaeliana *Blakely (Myrtaceae)*

Eucalyptus michaeliana is known from Yengo National Park and nearby areas, within the Wollombi Brook and the upper MacDonald River catchments. Indeed, NSWDECC (2008) reported that many of the sheltered drainage lines within central Yengo are dominated by this species. It is not surprising, therefore, that surveys within Wollemi would also uncover previously unknown populations of this taxon. Similar to the central Yengo habitat, within Wollemi *Eucalyptus michaeliana* was found to dominate sheltered habitats in tributaries of Wollemi Creek to the north-west of Mellong, although at this stage it is unknown how extensive these populations are. *Eucalyptus michaeliana* is a rare species spread across three meta-populations (Yengo-Wollemi, Oxley Wild Rivers-Guy Fawkes, Mt Barney in Queensland) and is not listed in threatened species legislation. An EOO of 28,697 km^2 and an AOO of 560 km^2 (n = 195) have been calculated for this taxon.

7. Grammitis stenophylla *Parris (Polypodiaceae)*

Two records in the Bionet Atlas show this small epiphytic fern for sites in the far south of Wollemi. One of these (SPJGI4614837) is an observation record made during remote helicopter survey of the Wollangambe River catchment in 2012. There appear to be no collections associated with this record, but habitat and landscape position are suitable. The second record refers to a specimen collection made from Gospers Creek on damp sandstone rocks (NSW 393914, R.G. Coveny, May 1976), and was confirmed by the species authority (B.S. Parris) in 1994. Given the superficial similarities of this species to other NSW *Grammitis* taxa (of which there are only two), it is likely that this taxon has been misidentified in the past and is present in many of the sheltered gullies in the southern Wollemi area. *Grammitis stenophylla* is listed as Endangered on the *BC Act 2016* however AVH records show it is distributed along the majority of the Australian coastal hinterland. An EOO of 820,124 km^2 and an AOO of 568 km^2 (n = 194) have been calculated for this taxon.

8. Grevillea parviflora *R.Br. subsp.* parviflora *(Proteaceae)*

Grevillea parviflora subsp. *parviflora* (Fig. 6) principally occurs in two main meta-populations within the Sydney Basin, one in south-western Sydney and the other between Wyong and Karuah. Additional to these, however, is a new smaller meta-population in the Mellong area of Wollemi and the adjacent Yengo National Park. During surveys in Wollemi in 2008, flowering and apparently clonal stands of this taxon were located in the Culoul Creek area just south of Mellong (NSW 975735, S.A.J. Bell, September 2008), and also in tributaries of Wollemi Creek to the north-west of Mellong (NSW 897212, S.A.J. Bell, June 2008; NSW 975732, S.A.J. Bell, September 2008). Habitat at these locations included open forest of *Eucalyptus fibrosa, Acacia undulifolia, Daviesia squarrosa, Macrozamia reducta, Lomandra glauca* and *Dianella revoluta* on lower slopes and flat ridges, with the threatened *Dillwynia tenuifolia* also present in the area. Further support for this new meta-population in the Mellong-Putty locality is provided by the several hundred records of this taxon shown in the Bionet Atlas for a private property immediately east of the Putty Road at Tinda Creek (e.g. SIXRI0988130, SIXRI0988252, SIXRI0988607). *Grevillea parviflora* subsp. *parviflora* is listed as Vulnerable on both the *BC Act 2016* and *EPBC Act 1999*. An EOO of 20,049 km^2 and an AOO of 912 km^2 (n = 4,533) have been calculated for this taxon, with significant outliers near Temora (CANB 779964.1, J. Johnston, September 1979) and Numeralla (CBG 9506469.1, M. Parris, October 1971) omitted.

Fig 6. *Grevillea parviflora* subsp. *parviflora* flowering on the Central Coast, December 2003.

9. Hibbertia coloensis *Toelken (Dilleniaceae)*

The showy shrub *Hibbertia coloensis* is known from only five AVH collections made between 2000 and 2008 along the Colo River in south-eastern Wollemi, where it grows in alluvial sand with *Tristaniopsis laurina* amongst sandstone boulders (Toelken 2013). Although a number of botanists have explored the south-eastern parts of Wollemi over many years, and apparently suitable habitat is more widespread, specimens of *Hibbertia coloensis* are only known from a short stretch (c. 1.2 km) of the Colo River. Notes associated with the Type specimen (NSW 721048, A.N. Rodd, October 2004) describe abundance as 'locally frequent' (Toelken 2013), however it is unknown if this comment applies only to the collection point or over a larger stretch of habitat. On current data, this species is therefore highly restricted and further targeted searches elsewhere along the Colo River and nearby larger creek systems such as Wollemi Creek are recommended. *Hibbertia coloensis* is a poorly collected and highly restricted rare taxon, but is currently unlisted on threatened species legislation. Although not documented, the susceptibility of this taxon to flood events may pose a particular threat, given its known habitat is unconsolidated alluvium of the larger creeks. An EOO of 4 km^2 and an AOO of 4 km^2 (n = 5) have been calculated for this taxon.

10. Homoranthus darwinioides *(Maiden & Betche) Cheel (Myrtaceae)*

There is a single collection of *Homoranthus darwinioides* shown in AVH for a site near Baerami on the northern edge of Wollemi (NSW 204051, B.G. Briggs, April 1987), but this locality is in error as the collection notes clearly state "*Cox's Gap, c.28 km west-southwest of Sandy Hollow*". Cox's Gap comprises a section of the Bylong Valley Way that is completely encompassed by Wollemi NP at this location, and the occurrence of *Homoranthus darwinioides* there appears valid. However, there have been no collections made from that site since 1987 (>30 years), and it is unknown if the species remains there. A second record from the Oz Mountain district on the western edge of Wollemi (CANB 682785.1, L.M. Copeland & T. Daniels, September 2000) is also questionable, given that site is known for the related *Homoranthus cernuus*: Copeland et al (2011) cite a specimen from this same area lodged by the same collectors on the same date as representative of *Homoranthus cernuus*. As a consequence, *Homoranthus darwinioides* remains known from Wollemi only through the 1987 collection at Cox's Gap, where at that time it was considered "*locally frequent*". Targeted searches and new collections from this locality would be desirable. *Homoranthus darwinioides* is listed as Vulnerable on both the *BC Act 2016* and the *EPBC Act 1999*. An EOO of 4,639 km^2 and an AOO of 108 km^2 (n = 68) have been calculated for this taxon, omitting the dubious record from Oz Mountain and re-projecting the Briggs record to the correct locality of Cox's Gap.

11. Monotaxis macrophylla *Benth. (Euphorbiaceae)*

Wildfire east of the Glen Gallic Trail near Martindale in mid-October 2013 stimulated mass germination of *Monotaxis macrophylla* (Fig. 7), a species largely unknown from the reserve prior to this event (Bell & Holzinger 2015). At this locality *Monotaxis* occurred predominantly on level or near level sandstone rock platforms and ridgelines, often co-occurring with the endangered *Commersonia rosea*. The first record of *Monotaxis* for Wollemi appears to be that made by Colin Gibson and Rob Miller in 1999, at Crypt Hill within Baerami Creek catchment, also "*scorched about a year or so*" previously (Gibson 2002). Crypt Hill lies c. 16 km to the west of the Glen Gallic population, and according to observation notes that population also occurred on sandstone rock platforms on ridgelines. Elsewhere in NSW, *Monotaxis macrophylla* is widely scattered in locations such as Cobar,

Howell, Glen Innes, Torrington, Bega and Moruya (Halford & Henderson 2002b; AVH records). Mass germination after fire has been reported for this species in many other locations, such as in South East Forests National Park near Bega (NSW 989541, J. Miles, December 2014) and on the Northern Tablelands (NE 68038, J.B. Williams, November 1998). *Monotaxis macrophylla* is listed as Endangered on the *BC Act 2016*. An EOO of 910,682 km^2 and an AOO of 396 km^2 (n = 149) have been calculated for this taxon.

Fig 7. *Monotaxis macrophylla* flowering and fruiting in northern Wollemi, October 2014.

12. Philotheca ericifolia *(A.Cunn. ex Benth.) Paul G.Wilson (Rutaceae)*

Philotheca ericifolia was removed from the (then) NSW *Threatened Species Conservation Act 1995* in late 2009. Prior to this it was listed as a Vulnerable species, but the extent of new records and size of populations uncovered at that time implied that it was a species no longer under great threat. Despite this, the species remains listed as Vulnerable under Commonwealth legislation. Several AVH collections have been made in the Dunns Swamp area of western Wollemi, near Olinda, from as early as 1969. This area has had a long history of plant survey by professional and amateur botanists due to the proximity of camping grounds near to the swamp, and as a consequence collections of many significant species have been made there. The most recent collection of *Philotheca ericifolia* (NSW 493735, R.L. Johnstone, December 2005) found it to be plentiful in habitat described as "*Pagoda outcrops on rocky ridge. Heathland in pockets, with* Leptospermum parvifolium, L. arachnoides, Calytrix tetragona, Ochrosperma oligomerum, Leionema lamprophyllum, Grevillea evansiana, Dillwynia rudis, Pultenaea *sp*. Olinda, Patersonia *sp*. *Skeletal sandy soil on sandstone*". Some other records for this species are unsubstantiated or unvouchered. An observation record contained in the Bionet Atlas (SPJGI3207733) shows this species for a location near Oz Mountain on the western fringe of Wollemi, made in July 1997. Examination of the original notes and collection associated with this record reveal that confirmation could not be achieved in 1997 due to an absence of fertile material, and this record should now be considered unconfirmed. A more recent Bionet Atlas observation (SJJSI0663883) from May 2017 occurs just within northern Wollemi at Baerami, and despite an absence of voucher specimen is assumed valid. No notes on population size and habitat are available for this record. *Philotheca ericifolia* is listed as Vulnerable on the *EPBC Act 1999*, but remains unlisted on the *BC Act 2016*. An EOO of 72,022 km^2 and an AOO of 336 km^2 (n = 131) have been calculated for this taxon.

13. Pomaderris queenslandica *C.T.White (Rhamnaceae)*

Pomaderris queenslandica (Fig. 8) occurs in a number of locations in the Goulburn River valley to the immediate north of Wollemi and in the upper Hunter district more generally (Bell 2001), but collections from within Wollemi itself have been few. New populations have been located, however, in the Kerrabee, Glen Gallic, Reedy Creek and Widden areas over the past decade. At Kerrabee, *Pomaderris queenslandica* occurs in a dry creek line with *Eucalyptus punctata, Acacia penninervis* subsp. *penninervis, Bursaria spinosa* and *Dodonaea viscosa* var. *cuneata*, over a ground layer of *Microlaena stipoides* var. *stipoides*, *Digitaria diffusa* and *Dichondra repens*. Further east at Glen Gallic, *Pomaderris queenslandica* was recorded on a ridgeline in open forest of *Eucalyptus fibrosa* sens. lat., with *Leucopogon muticus, Macrozamia reducta, Grevillea montana, Acacia piligera, Rytidosperma pallidum* and *Lomandra confertifolia* subsp. *rubiginosa*. This ridgeline habitat is unusual for the species, and although not searched it is suspected that nearby sheltered slopes and gullies support many more individuals. Similarly, on the escarpment above Reedy Creek scattered plants occur in open forest of *Angophora costata, Eucalyptus sparsifolia* and *Eucalyptus punctata*, with *Acacia penninervis* subsp. *penninervis* and *Daviesia ulicifolia* subsp. *ulicifolia*. Additionally, a Bionet Atlas record (SIXRI0074080), made in October 2009, shows this species for a small tributary within the lower Widden Valley (c. 8km south of its junction with the Goulburn River), but no details are available on habitat there. Other collections have been made in the Bylong Valley, adjacent to Wollemi (Bell & Driscoll 2014), and it is suspected that this species is widespread yet occurs only in small stands. *Pomaderris queenslandica* is listed as Endangered on the *BC Act 2016*. An EOO of 582,441 km^2 and an AOO of 632 km^2 (n = 303) have been calculated for this taxon, which outside of Wollemi extends across much of north-eastern New South Wales and eastern Queensland.

Fig 8. *Pomaderris queenslandica* flowering near north-western Wollemi, September 2015.

14. Prostanthera cineolifera *R.T.Baker & H.G.Sm. (Lamiaceae)*

The taxonomy of *Prostanthera cineolifera* (Fig. 9) has had a complicated history which is only now beginning to become clear. For a long time this taxon was difficult to separate from the closely related *Prostanthera lanceolata* and *Prostanthera ovalifolia*, and as a consequence the distribution of it was uncertain. Current taxonomic research is suggesting that *Prostanthera cineolifera* is more widespread than previously thought, with new collections recently being made from the north-western Wollemi area. Additionally, re-determinations of older collections from Wollemi are showing that they most closely match *Prostanthera cineolifera* (R. Palsson, pers. com.). One collection made in the Bylong Labyrinth section of Wollemi in the late 1990s (NSW 424206, S.A.J. Bell, October 1998) was initially determined as the threatened *Prostanthera discolor*, but is now considered to be the most westerly known population of *Prostanthera cineolifera*. Plants from this population were independently viewed and dismissed as *Prostanthera discolor* as early as 1999 by Gibson (2002), suggesting it instead to be a form of *Prostanthera ovalifolia*. More recently, as part of her revision to this group Ruth Palsson (UNE) inspected this population and attributed plants to *Prostanthera cineolifera*. Likely additional stands of this same taxon have been found in the Bylong State Forest area adjoining Wollemi, where it is plentiful, and specimens from there are currently attributed to *Prostanthera ovalifolia* (Bell & Driscoll 2014). *Prostanthera cineolifera* is listed as Vulnerable on both the *BC Act 2016* and the *EPBC Act 1999*. An EOO of 5,382 km^2 and an AOO of 80 km^2 (n = 107) have been calculated for this taxon, with the removal of some outliers: North Coast records of *Prostanthera cineolifera* in the Grafton and Walcha regions (e.g. NSW 973540, A. Carty, October 2014) are thought to represent a different un-named taxon, while specimens databased for the St Albans district (e.g. NSW 976082, K. Thumm, October 2014) represent the entity *Prostanthera* sp. Hawkesbury (B.J.Conn 2591).

Fig 9. *Prostanthera cineolifera* flowering in Pokolbin State Forest, October 2010.

15. Pultenaea 'monticola' *Mt Irvine (Fabaceae, Faboidea)*

Pultenaea glabra sens. lat. was included in the revision of *Pultenaea* possessing ovaries that were glabrous or supported tufted hairs (de Kok & West 2002). In that revision, *Pultenaea weindorferi* (from Victoria), *Pultenaea* sp. Olinda (Coveny 6616) (= *P.* sp. E) and *Pultenaea villosa* var. *glabrescens* Benth. (both New South Wales), and *Pultenaea setulosa* sensu Batianoff (Queensland) were placed in synonymy with *Pultenaea glabra*. However, as currently accepted in New South Wales *Pultenaea glabra* encompasses these and several other forms and further taxonomic work is a priority. One of these forms, occurring at high elevation in the Blue Mountains-Wollemi region on Wianamatta shale and adjacent areas, is *Pultenaea* '*monticola'* Mt Irvine (Douglas & David 2018). This entity reportedly differs from *Pultenaea glabra* sensu str. in the broader and bright green (not glaucous) leaves with a less pungent mucro, axillary rather than terminal inflorescences, and simple rather than furcate branching (Fig. 10). From the related *Pultenaea flexilis* it differs by the involute rather than flat leaves with sub-parallel veins, and the bright green leaf colour. *Pultenaea* '*monticola'* has been recorded as the dominant understorey taxon in open forest following fire within southern Wollemi north of Itchenstoke and near Green Scrub. While not currently described nor listed as threatened, this taxon remains of some significance due to uncertainty around its taxonomic position and distribution. EOO and AOO have not been calculated for this entity due to the uncertainty in point record locations and confusion with *Pultenaea glabra* and *Pultenaea flexilis*.

Fig 10. *Pultenaea* '*monticola'* Mt Irvine, flowering in Blue Mountains National Park near Mt Irvine December 2018 (Photograph: Steve Douglas).

16. Senecio linearifolius *var.* dangarensis *Belcher ex I.Thomps. (Asteraceae)*

Formerly known only from the type location at Mt Dangar in Goulburn River NP, a new population of *Senecio linearifolius* var. *dangarensis* (Fig. 11) was found recently by local residents Trevor and Andrew Woolley, on the northern edge of Wollemi c. 30 km to the south-east of Mt Dangar. At the time of survey in 2017 this site supported an estimated 14,000 individuals, exceeding that calculated for Mt Dangar (Bell 2017a). Habitat at this site is similar to that at Mt Dangar, both supporting woodland of *Eucalyptus moluccana* and occasionally *Brachychiton populneus*, on basalt soils with a well-developed grass and herb layer. Drought conditions over the last year have reduced the number of viable plants at

both the Mt Dangar and Wollemi sites considerably. *Senecio linearifolius* var. *dangarensis* is listed as Endangered on the *BC Act 2016*. An EOO of 21 km^2 and an AOO of 16 km^2 (n = 75) have been calculated for this taxon, using a cleaned dataset incorporating AVH, Bionet Atlas and undatabased records collected as part of current research on this species.

Fig 11. *Senecio linearifolius* var. *dangarensis* flowering in Goulburn River National Park, October 2015.

Updated taxonomy

Two taxa previously discussed in Bell (2008) as significant Wollemi species have now been formerly described (see below). No progress has been made on the taxonomy of other un-named species noted in that paper, including *Diuris* sp. aff. *punctata* (Colo River), *Eucalyptus* sp. 'Howes Swamp Creek' (Doherty 26), *Leionema* sp. 'Colo River' (Weston 2423), *Pomaderris* sp. aff. *nitidula* (Glen Gallic), *Prostanthera* sp. aff. *rotundifolia* (Mt Iris), *Pultenaea* sp. Olinda (Coveny 6616), and *Rulingia* sp. aff. *dasyphylla* (Goulburn River Valley).

Eucalyptus expressa *S.A.J.Bell & D.Nicolle (Myrtaceae)*

The tall stringy bark tree referred to in Bell (2008) as *Eucalyptus* sp. aff. *eugenioides* (Bees Nest Ridge), and recorded in Wollemi along the Hunter Range in the eastern portions of the reserve, has now been named as *Eucalyptus expressa* (Bell & Nicolle 2012). New records for Wollemi have also surfaced over the last decade, shown in the Bionet Atlas for Martindale Creek (SIXRI0605800) and in AVH for the Wolgan River area (NSW 496183, I. Olsen, June 2001; NSW 1001064, G.P. Phillips, September 2017). Material collected by N.C.W. Beadle (also from the Wolgan River) in July 1937 has been recently re-determined as *Eucalyptus expressa*, making this the earliest known collection of this taxon. Bell and Nicolle (2012) suggested a conservation risk code of 2KC, and an IUCN category of Data Deficient for this species.

Prostanthera stenophylla *B.J.Conn (Lamiaceae)*

Prostanthera sp. A (Rylstone), discussed in Bell (2008) for western parts of Wollemi near Dunns Swamp, has now been described as *Prostanthera stenophylla*. Apart from a dubious collection from the Canberra district, *Prostanthera stenophylla* is believed to be endemic to Wollemi where it occurs amongst the sandstone 'pagodas' in dry sclerophyll forest dominated by *Eucalyptus piperita, Eucalyptus rossii* and *Callitris endlicheri* (Conn 2006). This species is currently not listed as threatened, although Conn (2006) suggested that it be considered vulnerable due to its highly restricted distribution.

Excluded records

Six taxa shown in the Bionet Atlas and AVH databases for Wollemi have been dismissed from occurring in the reserve for the reasons discussed below.

Acacia alaticaulis *Kodela & Tindale (Fabaceae, Mimosoideae)*

Acacia alaticaulis was recorded along the Poppong Trail west of the Putty Road in 2007, approximately 4 km south of the Wollemi boundary but near to other known locations east of the Putty Road. This collection was briefly referred to in Bell and Holzinger (2015) as falling within Wollemi but that observation was made in error as the tenure of this land is largely Crown. There is also an AVH collection falling in the Mellong area of Wollemi (MEL 0117446A, D'Aubert, December 1988), however notes with that collection provide the locality as "*Putty Road, 27.5 km N of turnoff to Putty*" and "*Growing on road embankment near roadway*". Re-projection of this record places it in the general vicinity of other collections of this taxon, including an apparent duplicate of this record (NSW 211686, D'Aubert, December 1988) and locations highlighted in Kodela and Tindale (2013). All of these collections fall outside of Wollemi and this rare taxon currently remains unknown from the reserve.

Acrophyllum australe *(A.Cunn.) Hoogland (Cunoniaceae)*

Two collection records exist for the Vulnerable (*BC Act 2016* & *EPBC Act 1999*) *Acrophyllum australe* in the south of Wollemi, however both are considered erroneous. The first of these falls near the junction of Bowens Creek and the Wollangambe River, approximately 14 km north of Bilpin (NSW 248350, R. Horan, October 2003). However, collection notes advise the location to be "*1 km south on Browns Ridge trail from Bilpin to Burralow fire trail (2.9 km from Bells Line Road Bilpin via both these trails)*". There are no trails leading to or near the Wollangambe location, and both Browns Ridge Trail and Burralow Fire Trail (and Brown and Burralow Creeks) lie south of Bilpin in the adjacent Blue Mountains National Park. A second collection (NSW 899747, W.A. Cherry, December 1991) falls at Mountain Lagoon near Tootie Creek Trail in southern Wollemi, but the location given is "*Wildfire Ridge / Burralow Swamps*". Burralow Swamp forms part of Burralow Creek catchment in Blue Mountains National Park, south of Bilpin and Mountain Lagoon. *Acrophyllum australe* consequently remains unknown from Wollemi.

Allocasuarina glareicola *L.A.S.Johnson (Casuarinaceae)*

A single collection record (NSW 506318, R.L. Johnstone, December 2002) of the Endangered (*BC Act 2016* & *EPBC Act 1999*) *Allocasuarina glareicola* falls near the junction of Comleroy Road and Ruins Trail, in the south-eastern corner of Wollemi. This species occurs in a highly restricted area of western Sydney, generally bounded by the suburbs of Londonderry, Windsor Downs, Shanes Park and Castlereagh, and its occurrence along Comleroy Road seems unlikely. Indeed, notes associated with the Johnstone collection state "*c. 200 m NW of the northern end of Nutt Rd, Londonderry*", placing it well within the known range of this species and not in Wollemi.

Melaleuca biconvexa *Byrnes (Myrtaceae)*

There is a single Bionet Atlas record purportedly of the Vulnerable (*BC Act 2016* & *EPBC Act 1999*) *Melaleuca biconvexa* for a collection made near the Glow Worm Tunnel in the south-western corner of Wollemi. This record stems from the NSW Herbarium specimen register, with the catalogue number NSW 664310. However, on further inquiry this catalogue number actually refers to *Baeckea utilis* and not *Melaleuca biconvexa*, but the same collector and date are shown for both records (D. Crestani, January 2001). *Melaleuca biconvexa* is a small to large paperbark tree principally of low elevation swamps on the Central and South Coasts (Bell 2016, 2017b), and its occurrence so far inland and at high elevation would be highly significant.

Pterostylis nigricans *D.L.Jones & M.A.Clem. (Orchidaceae)*

A 1969 observation record (NSW 103683) in the Bionet Atlas for the Vulnerable (*BC Act 2016*) *Pterostylis nigicans* exists for an area just north of Mt Coricudgy, in the central part of Wollemi. This species normally grows on coastal sand habitats in northern New South Wales and Queensland (Jones & Clements 1988), and its presence in central Wollemi on high elevation sandstone would be highly unusual. Further investigation in the AVH reveals that this sighting record and its associated herbarium catalogue number actually refers to a spirit collection of an indeterminate *Genoplesium* sp. (NSW 103683, R.G. Coveny, March 1969), and is not a *Pterostylis*. The location notes associated with this collection, "*Middle Hill, c. 25 miles (40 km) E of Rylstone (between Mt. Corricudgy and Mt. Kerry)*", imply that the geospatial position is correct but that *Pterostylis nigricans* was not collected there, and this species therefore remains unknown from Wollemi.

Syzygium paniculatum *Gaertn. (Myrtaceae)*

Two AVH collection records (NSW 129335, L.A.S. Johnson, April 1953; NSW 280289, R. Melville, April 1953) at Kurrajong Heights (close to or just inside Wollemi) from the same gathering have been determined as the Endangered (*BC Act 2016*) *Syzygium paniculatum*. This species is primarily a coastal small tree of lower elevations, where it occurs in littoral and gallery rainforest (Payne 1991; Thurlby et al 2012). Notes with the two Kurrajong Heights collections state that they occurred "*on cleared Wianamatta shale*" and "*top of bank by roadside with* Syncarpia [laurifolia] glomulifera". These comments suggest that at the time (1953) there had already been extensive clearing at this locality, and that their occurrence likely falls outside of the current Wollemi boundary. Additionally, at least in recent times *Syzygium paniculatum* is a commonly planted species and although it is unknown if such plantings were widely undertaken 65 years ago, there remains the possibility that this specimen was not native to the area. This species therefore remains unknown from Wollemi until further clarification can be made.

Discussion

Over the past decade, a further sixteen significant vascular plant species have been newly recorded within Wollemi, or have surfaced in observation and specimen collection databases. This increases the total number of significant taxa for the reserve to 110. Under IUCN criteria, this incorporates 3 Critically Endangered, 16 Endangered, 27 Vulnerable, 4 Near Threatened, 39 of Least Concern and 21 Data Deficient (Appendix 1). Legally, 48 taxa or populations are listed as threatened under the NSW *Biodiversity Conservation Act 2016*, while 33 are similarly listed under the Commonwealth *Environment Protection and Biodiversity Act 1999*. In New South Wales, 1 taxon is listed as Critically Endangered, 19 as Endangered, 26 as Vulnerable and 2 as Endangered Populations. For Commonwealth listed taxa, 1 is listed as Critically Endangered, 9 as Endangered and 23 as Vulnerable (Fig. 12). Sixty-one taxa are currently unrepresented within either legislation and may be considered rare, while eight taxa remain scientifically undescribed. Following assessment of all newly added taxa against IUCN criteria, one currently unlisted species (*Hibbertia coloensis*) qualifies as Critically Endangered, while a second (*Bertya linearifolia*) qualifies as Endangered (see Appendix 1).

Taxonomy is a slow-moving science with new collections of novel entities regularly being found but official descriptions often taking many years or decades to finalise. It is therefore not surprising that new taxa and revisions to existing taxonomic groups result in additions to the flora of an area. Many newly described taxa are yet to be formally assessed for conservation status, and for new entities extracted out of species complexes it is difficult to determine their status when previous confusion with related species impacts on identification. For example, *Hibbertia pustulata* was formerly part of the *Hibbertia rufa* complex and occurs in both Blue Mountains and Wollemi National Parks, but is restricted to swampy habitats which are not widespread across the landscape (Toelken & Miller 2012). There is currently insufficient information and collections for this taxon to determine how significant it is, particularly given previous confusion with other species in the '*rufa'* group. Similarly, the rare *Epacris browniae* has been recently described for populations growing at high elevation in the Blue Mountains area (Coleby 2015), and although records exist close to Wollemi none have yet been located within this reserve, perhaps due to confusion with other more common epacrids.

A decade on from the last assessment of significant species, Wollemi National Park remains an important conservation reserve for the protection of a wide array of plant species and their habitats. The 110 taxa detailed here is an impressive number, yet this quantum is unlikely to be exhaustive. Eight of the forty-two significant taxa listed in Bell (2008) as potentially occurring within Wollemi have now been confirmed for the reserve. More of the remaining thirty-four potentially still occur there but await fortuitous discovery by keen bushwalkers and botanists. Other taxa not currently recognised as rare or threatened may also be added to this list: the inclusion of *Bertya linearifolia* and *Hibbertia coloensis* in this paper as significant taxa is based solely on the paucity of collections and observations (<5 of each) within AVH and Bionet Atlas databases. There will inevitably be further poorly collected taxa like these that currently 'slip under the radar' of threatened species assessments, and it may not be until they are formally assessed and legally protected that their presence in Wollemi will be noted.

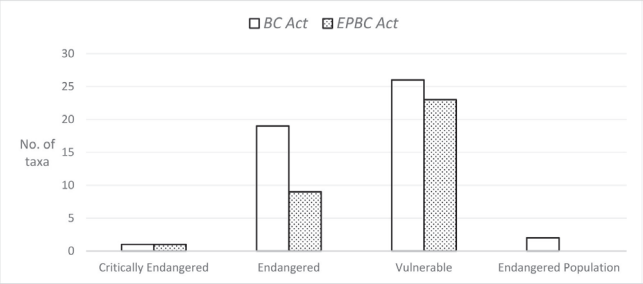

Fig 12. Summary of legally protected taxa known from Wollemi National Park.

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Appendix 1 Significant vascular plants known from Wollemi National Park showing threatened species conservation codes

IUCN codes are as documented in Bell (2008), except for newly discussed taxa (marked *) which have been assessed against IUCN (2017) guidelines. Entries shown within '[ ]' are pre-existing codes from the literature; all others are newly applied here.

Taxon	IUCN Category	EPBC Act	BC Act	ROTAP code
Critically Endangered CR				
Wollemia nobilis	[CR D]	CE	CE	[2ECit]
Eucalyptus sp. '*Howes Swamp Creek'* (Doherty 26)	CR D1	E	E	[2ECi]
**Hibbertia coloensis*	CR B1ac; B2ac; C2a			2EC-
Endangered EN				
Zieria involucrata	EN A1a; B1ac	V	E	[2VCa]
Macrozamia elegans	EN A2ad			[2VC-]
**Senecio linearifolius* var. *dangarensis*	EN A2a; B1ac		E	2EC
**Bertya linearifolia*	EN B1ac; B2ac; D1			[2E]
Persoonia hirsuta var. *evoluta*	EN B1ac	E	E	[3KCi]
Persoonia marginata	EN B1ac	V	V	[2V]
Pimelea curviflora var. *curviflora*	EN B1ac	V	V	[2VC-]
Pultenaea sp. (Olinda)	EN B1ac		E	[2EC-]
**Commersonia rosea*	EN B2ac	E	E	[2E]
**Monotaxis macrophylla*	EN B2ac		E	3VC
**Pomaderris queenslandica*	EN C2a		E	[3VCi]
Asterolasia elegans	EN C2b	E	E	[2ECa]
Baeckea kandos	EN D1	E	E	[2RC-t]
Gyrostemon thesioides	EN D1		E	[2EC]
Haloragodendron gibsonii	EN D1			[2RCat]
Pomaderris sericea	EN D1	V	E	[3VCi]
Vulnerable VU				
Acacia pubescens	VU A2bc	V	V	[3VCa]
**Dillwynia tenuifolia*	VU B1ac		V	[2RCa]
Ozothamnus tesselatus	VU B1ac	V	V	[2VC-]
Olearia cordata	VU B1ac; C2b	V	V	[2VCi]
Velleia perfoliata	VU B2ac; D1	V	V	[2VC-]
**Grevillea parviflora* subsp. *parviflora*	VU C2a	V	V	3VC
**Homoranthus darwinioides*	VU C2a	V	V	[3VCa]
Melaleuca deanei	VU C2a	V	V	[3RC-]
Melaleuca groveana	VU C2a; D2		V	[3RC-]
**Eucalyptus fracta*	VU D1		V	[2R-]
Pomaderris precaria	VU D1			[2VC-; 2EC-]
Grevillea obtusiflora subsp. *obtusiflora*	VU D1+2	E	E	[2E]
Leptospermum spectabile	VU D1+2			[2RC-; 2RCt]
Cynanchum elegans	VU D2	E	E	[3ECi]
Epacris coriacea	VU D2			[3RC-]
Epacris muelleri	VU D2			[3RC-]
Eucalyptus aenea	VU D2			[2RC; 2RC-]
Eucalyptus bensonii	VU D2			[2RC-t]
Eucalyptus burgessiana	VU D2			[2RCa]
Eucalyptus corticosa	VU D2		V	[2VC-]
Isotropis foliosa	VU D2			[3KC-]
Leionema scopulinum	VU D2			[2RCit]
Pentachondra dehiscens	VU D2			[3RC]
Pomaderris bodalla	VU D2		V	[2R]
Prostanthera cryptandroides subsp. *cryptandroides*	VU D2	V	V	[2RC-t; 2VC-]

Taxon	IUCN Category	EPBC Act	BC Act	ROTAP code
Prostanthera discolor	VU D2	V	V	[2VC-]
Prostanthera stricta	VU D2	V	V	[2V]
Near Threatened NT				
Acacia bynoeana	NT	V	E	[3VC-]
Acacia gordonii	NT	E	E	[2K]
**Cymbidium canaliculatum*	NT		EP[1]	3RCa
Leionema sympetalum	NT	V	V	[2VC-]
Least Concern LC				
Acacia asparagoides	LC			[2R]
Acacia bulgaensis	LC			[2RC-]
Acacia flocktoniae	LC	V	V	[2VC-]
Acacia fulva	LC			[2RC-; 2RCa]
Acacia matthewii	LC			[3RC-]
Acacia subtilinervis	LC			[3RCa]
Almaleea incurvata	LC			[2RC-t; 2RC-]
Apatophyllum constablei	LC			[2EC-; 2RCa]
Atkinsonia ligustrina	LC			[2RCa]
Banksia penicillata	LC			[3RC-]
Boronia floribunda	LC			[2RC-]
Boronia fraseri	LC			[2RCa]
Boronia rubiginosa	LC			[2RCa]
Callistemon shiressii	LC			[3RC-]
Darwinia peduncularis	LC		V	[3RCi]
Eucalyptus cannonii	LC		V	[2VCi; 2RCa]
Eucalyptus fergusonii subsp. *dorsiventralis*	LC			[2RC-]
Eucalyptus hypostomatica	LC			[3RC-]
**Eucalyptus michaeliana*	LC			[3RCa]
Eucalyptus prominula	LC			[2KC-]
Gonocarpus longifolius	LC			[3RC-; 3RCa]
**Grammitis stenophylla*	LC		E	3RCa
Grevillea evansiana	LC	V	V	[2VC-; 2VCa]
Grevillea johnsonii	LC			[2RCi; 2RCa]
Grevillea montana	LC			[2KC-; 2RCa]
Homoranthus cernuus	LC			[2RCa]
Leucochrysum graminifolium	LC			[2R; 2RC-]
Lissanthe sapida	LC			[3RCa]
Lomandra fluviatilis	LC			[3RCa]
Olearia quercifolia	LC			[3RC-]
**Philotheca ericifolia*	LC	V		[3RC-]
Philotheca obovalis	LC			[3RCa]
Platysace clelandii	LC			[2RCa]
Prostanthera hindii	LC			[2KC-]
Pseudanthus divaricatissimus	LC			[3RCa]
Rulingia hermanniifolia	LC			[3RCa]
Rupicola ciliata	LC			[2RC-t]
Rupicola decumbens	LC			[2RC-]
Tetratheca glandulosa	LC		V	[2VC-]
Data Deficient DD				
Blechnum gregsonii	DD			[2RCa]
Boronia barkeriana subsp. barkeriana	DD			[2RC-]
Brasenia schreberi	DD			[3RC-+]
Cyphanthera scabrella	DD			[2RC-]

Taxon	IUCN Category	EPBC Act	BC Act	ROTAP code
Diuris sp. aff. *punctata* (Colo River)	DD			[2KC]
Eucalyptus gregsoniana	DD			[3RCa]
Eucalyptus expressa	DD			[3KC; 2KC]
Kennedia retrorsa	DD	V	V	[2VCa; 2VCi]
Leionema lamprophyllum subsp. *orbiculare*	DD			[2R-]
Leionema sp. 'Colo River' (Weston 2423)	DD			[2VC-]
Pomaderris brunnea	DD	V	E	[2VC-]
Pomaderris pauciflora	DD			[3RC-]
Pomaderris sp. aff. *nitidula (*Glen Gallic)	DD			[2KC]
**Prostanthera cineolifera*	DD	V	V	[2K]
Prostanthera stenophylla	DD			[2KC-]
Prostanthera sp. aff. rotundifolia. (Mt Iris)	DD			[2KC-]
Pultenaea glabra	DD	V	V	[3VCa]
**Pultenaea 'monticola'* Mt Irvine	DD			2KC
Rulingia sp. aff. dasyphylla (Goulburn R. Valley)	DD			[2KC]
Seringia denticulata	DD		EP[2]	[3RC-]
Swainsona recta	DD	E	E	[3ECi]

EP[1] = Endangered Population in the Hunter catchment
EP[2] = Endangered Population in Hawkesbury local government area