

NSW Threatened Species Scientific Committee

Conservation Assessment of *Grevillea wilkinsonii* Makinson (Proteaceae)

J Scott, TD Auld & A Chalmers 04/05/2020
NSW Threatened Species Scientific Committee

***Grevillea wilkinsonii* Makinson (Proteaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Endangered

Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act and EPBC Act: Critically Endangered

Conservation Advice: *Grevillea wilkinsonii*

Summary of Conservation Assessment

Grevillea wilkinsonii was found to be eligible for listing as Critically Endangered under IUCN Criterion B1ab(iii, v). Taking the lower bound for the number of mature individuals in Criterion C, *Grevillea wilkinsonii* is Critically Endangered via C2a(ii). The main reasons for the species being eligible are: i) the species has a very highly restricted geographic range; ii) the species is severely fragmented; (iii) there are a number of threats causing continuing decline; (iv) the number of mature individuals is very low; and (v) >90% of mature individuals are in a single population.

Description and Taxonomy

Grevillea wilkinsonii is described by PlantNET 2019 as an “ascending or erect to spreading* shrub to 2 m high. Leaves narrow-oblong or oblong-elliptic mostly 10–17 cm long, 8.5–21 mm wide, margins flat, regularly toothed with teeth to 4 mm long, terminating in a weak spine 1–2 mm long, upper surface glabrous or with a sparse inconspicuous indumentum of appressed hairs, lower surface sericeous. Conflorescences usually deflexed, secund. Perianth brownish to reddish pink or purple, loosely subsericeous outside, glabrous inside. Gynoecium 14–15 mm long; ovary sericeous, subsessile to very shortly stipitate; style lilac pink, glabrous; pollen presenter broadly and obliquely conical. Follicle subsericeous with reddish blotches”. *Grevillea wilkinsonii* flowers in October and November (PlantNET Mar 2019).

* One small population near Gundagai has a prostrate to decumbent habit, maintaining the near-prostrate habit from cuttings (B. Makinson *in litt.* November 2016).

Grevillea wilkinsonii Makinson is the accepted scientific name in the Australian Plant Census (APC 2018). It has the common name of the ‘Tumut Grevillea’ (PlantNET 2019).

Distribution and Abundance

Grevillea wilkinsonii is largely restricted to riparian vegetation along the Goobarragandra River east of Tumut on the New South Wales south-west slopes

NSW Threatened Species Scientific Committee

(Makinson 1993; Taws 2013; OEH 2018). Another small natural population occurs near Gundagai consisting of eight mature individuals (J. Briggs *in litt.* March 2018).

The Goobarragandra River population

The 'Goobarragandra' or 'Type form' population, is the larger of the two known populations and the plants form consistently upright, spreading shrubs. It is distributed along the Goobarragandra River for approximately 5.5-6 km, with occasional outlier patches further downstream (B. Makinson *in litt.* November 2016). These outlier patches occur on riverbanks and shingle bars downstream for approximately 6 km and were observed in the past but have since been eliminated by recent severe flooding. These areas are not considered to be favourable for the persistence of the species as they occur on a floodplain, with little or no remnant of the riparian zone left, with stock grazing and pasture grass to the water's edge, along with highly erodible river banks (B. Makinson *in litt.* November 2016).

The majority (approximately 80%) of the *G. wilkinsonii* population along the Goobarragandra River occurs on private freehold land, with the remainder occurring on two Crown Land sites (NSW NPWS 2001), and one site just within the boundary of Kosciuszko National Park. One of the Crown Land sites is now a reserve for Environmental Protection and the second is a Travelling Stock Reserve (TSR). Both have been fenced to exclude stock (NSW NPWS 2001).

Various sources (Makinson 1993; NPWS 2001; Taws 2013; Westman n.d.) document the distribution of *Grevillea wilkinsonii* along the river as consisting of a number of 'populations', 'sites' or 'colonies', some of which are natural and some planted. All of these terms appear to refer to discrete patches of plants that are not necessarily genetically isolated from other patches but are numbered/labelled for management and survey purposes (NSW NPWS 2001). For the purpose of this assessment, all currently known *Grevillea wilkinsonii* plants along the Goobarragandra River may be regarded as one population.

The Goobarragandra River population may also be considered as one location, using the IUCN (2017) definition as a "geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present." Most threats (see threat section below) impact on the plants and their habitat along the length of the river where the population occurs. A major flooding event can affect the population along its length, as can weed invasion, with flooding exacerbating the weed problem by dispersing weed propagules and exposing soil to colonisation by opportunistic weed species. Much of the private land, where 80% of the population occurs, is often used for stock grazing (NSW NPWS 2001; DOE n.d.). Crown Land has been accessible to domestic stock in the past (NSW NPWS 2001).

The Gundagai population

The site near Gundagai (referred to as the Gundagai population) is located on a hillside close to the town centre on two private properties. Five plants occur in a small remnant (0.5 ha) of White Box (*Eucalyptus albens*) Grassy Woodland, and three plants are located in a private backyard (OEH n.d.; J. Briggs *in litt.* August 2016). The plants have a prostrate to decumbent growth habit.

NSW Threatened Species Scientific Committee

The Gundagai population is separated from the Goobarragandra River population by approximately 40 km and is regarded as a separate location (as defined by IUCN 2017).

Geographic distribution

Grevillea wilkinsonii has a very highly restricted geographic distribution. The extent of occurrence (EOO) was estimated to be 40 km², based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2017). The area of occupancy (AOO) was estimated to be 16 km². This calculation was based on the species occupying four (2km x 2km) grid cells, the spatial scale of assessment recommended by IUCN (2017).

Abundance

Various surveys of *Grevillea wilkinsonii* have been undertaken at the Goobarragandra River population since 1998 (Taws 2011, Taws 2013, Taws 2018). The plants have been consistently categorised into 3 size classes: seedling (0.1-0.2 m), mid-size (0.2-1 m) and adult (>1 m). The adult plants were the only ones considered to be reproductive individuals (Taws 2013). When the population was first surveyed in 1998, there were 298 mature individuals (individuals >1m) from a total of 644 plants (Taws 2018). Since 1998, the total number of plants in the naturally occurring patches (not including translocated individuals) has declined from 644 (298 mature) to 514 (291 mature) in 2008, 399 (268 mature) in 2011, 210 (127 mature) in 2012, and 192 (97 mature) in 2017 (Taws 2018). This represents a 70% decrease in the total number of plants in the naturally occurring patches (and a 67% decline in mature individuals) over 19 years. The largest declines have been the result of flood events in 2010 and 2012. The 2012 flood washed away three of the 13 sites along the river, and since then there has been no regeneration at these three sites (Taws 2018).

A Recovery Team was established in 1992 by the NSW National Parks and Wildlife Service and continues today under the Department of Planning, Industry and Environment, monitoring and managing both populations. Since 1993, plants have been propagated from cuttings and seed (sourced from within the population) and planted in existing sites and at new sites within the habitat of *Grevillea wilkinsonii* to enhance the population. In 2017, the total number of plants, both naturally occurring and planted, was 1517, including both mature and immature individuals (Taws 2018). Of the total number of individuals, 682 were recorded in the adult size class of >1m in height (the majority of which had resulted from translocations). Today, 87% of the existing population (mature and immature plants) comprises translocated individuals and their progeny, with one site being entirely comprised of translocated individuals and containing 62% of the total population (Taws 2018).

Approximately 50% of the natural population and 75% of translocated individuals (that had been planted since 2000) were washed away due to severe floods in September 2010 and March 2012 (Taws 2013; Briggs and Hunter 2018). Recovery of natural populations after the 2012 flood has been very poor (J. Briggs *in litt.* April 2016). Whilst flooding is a natural disturbance event in riparian areas and provides new opportunities for plant recruitment, the flood in 2012 was so severe it altered the

NSW Threatened Species Scientific Committee

river bank morphology and removed much of the riparian vegetation within the distribution of *G. wilkinsonii* (Taws 2018). With the loss of significant habitat, regeneration in many areas may not be possible (J Briggs pers. comm. May 2019). Sites where numbers are increasing are those that have translocated individuals and are located above the 2012 record flood level (J Briggs pers. comm. June 2019).

IUCN (2017) state that wild subpopulations resulting from introductions outside the natural range should only be included in assessments if certain conditions are met: (a) intent was to reduce extinction risk, (b) introduced population is geographically close to natural range, (c) introduced subpopulation has produced viable offspring, and (d) at least five years have passed since the introduction. Self-sustaining translocated individuals or subpopulations re-introduced within the taxon's natural range, regardless of the original goal of the translocation or re-introduction, may be included (IUCN 2017). In the case of *G. wilkinsonii*, individuals have been re-introduced within its natural range and at least five years have passed since the introductions. To be viable and self-sustaining, the offspring also need to be established and producing their own viable offspring (i.e. producing seeds and new recruits). The translocated individuals at a few sites have established and are recruiting (Taws 2018). At other sites, patches of translocated individuals (e.g. TSR plantings) are not recruiting due to weed growth which is thought to be outcompeting *G. wilkinsonii* seedlings (Taws 2018), and these plants are ineligible to be included in the count of mature individuals for the IUCN assessment. Other new sites were only planted in 2013 and the first offspring were only observed in 2018 (J Briggs pers. comm. May 2019). Due to this difficulty in ascertaining if the translocated individuals can be included in the total number of mature individuals as defined by IUCN (2017), an upper and lower bound for total mature population size was estimated. The lower bound of 105 mature individuals only includes the natural sites along the Goobarragandra River and the naturally occurring Gundagai plants, while the upper bound of 547 mature individuals includes the total number of adult plants in all the natural sites and translocation sites that were planted prior to 2013 (Taws 2018).

There are currently known to be eight mature *Grevillea wilkinsonii* plants in the Gundagai population (J. Briggs *in litt.* Aug 2016). In addition, three or four plants grown from cuttings have been planted by the landowner on a nearby embankment. A few seedlings have now established in the bare ground in the vicinity of these translocated plants (J. Briggs *in litt.* Aug 2016). Eighteen seedlings were recently planted at this site and are being monitored for survival (J Briggs pers. comm. May 2019). The long-term viability of this site is uncertain, given its small size, its private land tenure and the potential impact of disturbance and weeds. Ongoing management and landholder cooperation are required to maximise the likelihood of the species persisting at this site.

Ecology

The habitat of the Goobarragandra population is rocky riverbanks, terraces that may be flooded and adjacent slopes along the Goobarragandra River. Most plants grow in close proximity to the river, often within the flood zone and almost always within the surviving belt of native riparian vegetation. Where the riparian vegetation extends further upslope *Grevillea wilkinsonii* may also occur outside the flood zone and up to about 40m from the river (B Makinson *in litt.* November 2016). The altitude of sites

NSW Threatened Species Scientific Committee

where *G. wilkinsonii* occurs on the Goobarragandra River is between 310 m and 340 m above sea level (NSW NPWS 2001).

The Goobarragandra population occurs on a variety of substrates including granitic and granodioritic rocks (in crevices and between outcrops) and at a couple of places on loams derived from serpentinite, but also in sand and sand/silt pockets and flood terraces that are unlikely to be derived from the local substrates but have instead been deposited from upstream environments. As most of the serpentinite areas have been cleared for grazing, the present distribution of the species may not reflect a preference for granitic substrates but may represent a local refuge following European colonisation (Makinson 1993). *Grevillea wilkinsonii* occurs within remnant riverine shrub communities adjacent to open forest where the most common tree species are *Eucalyptus blakelyi*, *E. bridgesiana*, *E. melliodora* and *E. macrorhyncha*, with *Brachychiton populneus* growing in nearby paddocks (Makinson 1993; NSW NPWS 2001). Taller shrubs of the lower slopes and riverbanks include *Leptospermum brevipes*, *L. obovatum*, *Lomatia myricoides*, *Hakea microcarpa*, *Kunzea ericoides*, *Acacia melanoxylon*, *A. pravissima*, *Bursaria lasiophylla*, *Callistemon sieberi*, *Pomaderris angustifolia*, *Dodonaea viscosa* subsp. *spatulata* and *Xanthorrhoea glauca* subsp. *angustifolia* (NSW NPWS 2001). Smaller shrubs include *Grevillea lanigera*, *Calytrix tetragona*, *Correa reflexa* and *Crowea exalata* (NSW NPWS 2001).

The population structure of *Grevillea wilkinsonii* covers a wide range of size classes suggesting that recruitment is reasonably frequent (NSW NPWS 2001) and numerous seedlings have been observed at some sites in the Goobarragandra population (Taws 2018). Repeated surveys of the Goobarragandra population in 1998, 2008, 2011, 2012 and 2017 indicate that the relative proportion of seedling (0.1-0.2 m), mid-size (0.2-1 m) and larger plants (>1 m) varies considerably between sites and survey times (Taws 2011, Taws 2013, Taws 2018). Variability in plant numbers and size distributions among different sites and survey times can be primarily explained by flood disturbance, with other factors being cattle browsing, the effects of drought, availability of bare ground and canopy openings and the density of other shrubs (native and exotic). Up until 2011, adult *G. wilkinsonii* plants had appeared to cope with floods with a reduction of only 8% in numbers (after the floods of 2010) and evidence of resprouting from branches and the base of adult plants (Taws 2011). However, the extreme flood event in 2012 stripped much of the banks back to bedrock at many sites where *G. wilkinsonii* had occurred on the Goobarragandra River. This extreme flood removed living plants and probably most of the soil seed bank (B. Makinson *in litt.* May 2016) and areas of habitat (J Briggs *pers. comm.* May 2019). Similar to other riparian species occurring on alluvial streams, the seedlings of *G. wilkinsonii* may be buried by sediment and organic debris deposited by floods and larger plants may be negatively affected by soil being washed away from around their roots (Taws 2011).

Grevillea wilkinsonii is likely to be fire sensitive, regenerate from seed, and have a life span of approximately 10-20 years (Makinson 1993), although some plants may live for more than 30 years. Observations of an *ex-situ* population of *G. wilkinsonii*, in early December 1998, noted the death of adult plants and subsequent germination of seedlings after a low intensity wildfire (DOE n.d.). Adult plants start to become

NSW Threatened Species Scientific Committee

senescent, elongated and sparsely foliated after about 20 years, with the peak of flower and seed production most likely to be between about 8 and 15 years. However, those plants growing within the flood-zone may become damaged back to their bases and recover. Flowering is prolific, being concentrated in October and November, with a weak second flush in autumn (Makinson 1993). Fruit and seed set in *G. wilkinsonii* is reportedly high. However, predation of ripening fruits by parrots is high and combined with the possible loss of seeds to rodents after seed release (as occurs in closely related grevilleas (Auld and Denham 1999)) may be limiting input to the soil seed bank and hence recruitment (B. Makinson *in litt.* November 2016; Makinson 1993; NSW NPWS 2001; OEH n.d.). Ants may play a role in local seed dispersal as the seeds have an elaiosome and are quickly taken by them. In one instance, seedlings have been found emerging from an ant nest (Makinson 1993; NSW NPWS 2001). Observations over more than 20 years suggest new seedlings emerge in spring.

The Gundagai population occurs in a small remnant of <1 ha of grassy White Box (*Eucalyptus albens*) woodland with scattered shrubs of *Ricinocarpos bowmanii* and *Dodonaea viscosa*, and a groundcover dominated by *Themeda triandra* and *Poa sieberiana* (OEH 2018). It occurs on the upper slope of a steep hill on serpentinite geology (OEH 2018) and is surrounded by cleared land.

Threats

Loss and degradation of habitat by clearing for agriculture has been a threat in the past and continues to threaten some patches of *Grevillea wilkinsonii* (OEH 2018). The main threats currently affecting *G. wilkinsonii* include grazing and erosion caused by stock, weed invasion (mainly blackberry, but also exotic grasses), severe flooding events, climate change, inappropriate herbicide use, and localised disturbances (Makinson 1993; NSW NPWS 2001; OEH n.d.).

Grazing: Seven of the nine natural sites of *G. wilkinsonii* in the Goobarragandra population are subject to various degrees of browsing damage and habitat degradation associated with domestic stock (NSW NPWS 2001). Following the survey in 2012, Taws (2013) recommended ongoing exclusion of domestic stock from the sites to ensure the survival of plants, particularly seedlings.

Weed Invasion: The main weed species present within the habitat of *Grevillea wilkinsonii* along the Goobarragandra River include *Rubus fruticosus* (Blackberry), *Salix* sp. (Willow), *Populus nigra* (Lombardy Poplars), *Paspalum dilatatum* (Paspalum), *Phalaris aquatica* (Phalaris), *Rosa rubiginosa* (Briar Rose), *Verbena* sp. (Verbena), *Malus* and *Prunus* shrubs and *Hypericum perforatum* (St John's Wort) (NSW NPWS 2001; OEH 2018; B. Makinson *in litt.* May 2016). These weeds cause loss and degradation of habitat by smothering and shading *G. wilkinsonii* individuals. Exotic grasses can outcompete *G. wilkinsonii* seedlings thereby limiting recruitment (Taws 2018; B. Makinson *in litt.* November 2016). A longer-term problem is the proliferation of *Populus nigra* (Lombardy Poplar) trees along the river, which are establishing at many sites and will soon grow to a size where they commence suckering (B. Makinson *in litt.* May 2016). These will likely adversely affect *G. wilkinsonii* survival and recruitment.

NSW Threatened Species Scientific Committee

Flooding: The Goobarragandra River has a regular regime of flooding (B. Makinson *in litt.* November 2016). Due to the topography of the valley profile (much of it steep or at least with raised banks), and the linear and narrow nature of the native vegetation remnants, *Grevillea wilkinsonii* is probably dependent for continued replacement of flood-zone plants on seed dispersal from plants situated higher upslope and/or upstream. The newly exposed soil created by each flood event may provide opportunities for seedling emergence and establishment for both *G. wilkinsonii* and also weeds (B. Makinson *in litt.* November 2016).

When there is an extreme flood event, as seen in 2012, effective recruitment of plants post-flooding does not necessarily occur. The 2012 extreme flood entirely removed or deeply buried much of the existing soil seed bank and removed many of those upslope plants which sustained recruitment at several sites after mortality from smaller sized floods. As a result of this flood there was total removal of all plants (and in many cases soil) at three sites (Taws 2013), and substantial removal at several more sites (B. Makinson *in litt.* November 2016). Overall, the area of suitable habitat was reduced as a result of the 2012 flood (J Briggs pers. comm. May 2019).

Climate Change: Climate change predictions for the Murray Basin (which includes the habitat for *Grevillea wilkinsonii*) are for an increase in the intensity of rainfall events (Timbal 2015) leading to severe flooding. Conversely, if projected snowfall declines (Timbal 2015), there may be less snow-melt and runoff from the western side of the Kosciuszko plateau, which would influence the flood regime of the Goobarragandra River (B. Makinson *in litt.* November 2016). If, as projected, snowfall declines, there may be less frequent 'normal' seasonal floods. This too could be a problem as it may favour more closed ground layer vegetation such as introduced grasses occupying habitat down to the river edge.

Herbicide use and localised disturbances: Localised disturbances such as spraying of herbicides, or addition of fertilisers in nearby cleared paddocks, pose a potential threat to *Grevillea wilkinsonii* plants (OEH 2018; Taws 2013). Trampling by pets or domestic stock and landscaping activity may be a potential threat to patches of *G. wilkinsonii* (OEH 2018).

Severe fragmentation

IUCN Red List Guidelines (2017) and NSW Threatened Species Scientific Committee guidelines (2018) state that *“the phrase ‘severely fragmented’ refers to the situation in which increased extinction risks to the taxon results from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonization.....A taxon can be considered to be severely fragmented if most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance.”*

The distance between the two known populations of *Grevillea wilkinsonii* is approximately 40 km. Much of the land surrounding and between these populations

NSW Threatened Species Scientific Committee

has been cleared and grazed by domestic stock (NSW NPWS 2001). There is no possibility of natural seed dispersal from the Goobarragandra population to the Gundagai population should the Gundagai population be lost.

The long-term viability of the Gundagai population is reliant on ongoing active management. With less than 10 mature plants located in <1 ha of habitat surrounded by cleared land, the future of this population requires close monitoring, habitat restoration, and the effective control of ongoing threats. As the population is located on two private properties, the cooperation of present and future landholders is necessary. Overall, the long-term viability of this site is uncertain, given its small size and the impact of disturbance and weeds and the need for ongoing management to maximise the likelihood of the species persisting at the site.

The Goobarragandra population extends for several kilometres along the river, where there are patches of *Grevillea wilkinsonii* plants interspersed with gaps of a few hundred metres of unoccupied habitat. The Goobarragandra population constitutes 75% of the area of occupancy (three (2km x 2km) grid squares) for the species. Genetic studies by Westman (n.d.) indicated fragmentation of the patches and habitat within the Goobarragandra population may be a contributing factor in the low levels of genetic variability found across the various patches along the river. Three small *G. wilkinsonii* sites along the river were lost in the 2012 flood and there has been no subsequent regeneration (Taws 2018). Some habitat may no longer exist, or it may be smaller and/or no longer suitable, or seed may not have been dispersed into these areas. So, even though the habitat patches may be within a few hundred metres of each other, they may be too disturbed to facilitate recruitment of new plants. Both these factors indicated that some of the patches along the river may not be viable. A precautionary approach would be to consider that >50% of the total area of occupancy of *G. wilkinsonii* is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Grevillea wilkinsonii* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Overall Assessment: *Grevillea wilkinsonii* was found to be eligible for listing as Critically Endangered under Criterion B1ab(iii, v). Taking a precautionary approach (the lower bound for the number of mature individuals) in Criterion C, *G. wilkinsonii* is also Critically Endangered via C2a(ii).

Criterion A Population Size reduction

Assessment Outcome: Data Deficient

Justification: Whilst the natural population of *G. wilkinsonii* has undergone a reduction of 70% in 19 years largely due to the flood of 2012 and other ongoing threats, this decline may be partly compensated by growth in numbers in the planted sites. The decline seen in plant numbers in the naturally occurring sites (Taws 2018) indicates the natural population is declining rather than experiencing a fluctuation. The success

NSW Threatened Species Scientific Committee

of translocated individuals in two new sites, in particular, has led to an overall increase in the total number of individuals. However, translocated individuals can only be considered as mature individuals and counted in the overall population numbers for an IUCN assessment if they have established, produced their own viable offspring and are self-sustaining (IUCN 2017). Whilst a large number of the translocated individuals have produced offspring that may prove to be viable in the longer-term, others have not (particularly more recent translocations and sites affected by dense weed growth that is inhibiting seedling establishment). Hence, the number of translocated individuals that can be included in the total number of mature *G. wilkinsonii* individuals for an assessment of decline is uncertain. As such, any reduction in the size of the *G. wilkinsonii* population is difficult to quantify, hence the species is considered Data Deficient under this criterion.

Criterion B *Geographic range*

Assessment Outcome: Critically Endangered via B1ab(iii, v).

Justification: The geographic distribution of *Grevillea wilkinsonii* is very highly restricted. The estimate of the extent of occurrence (EOO) is 40 km², and the area of occupancy (AOO) is 16 km². A species with an EOO of less than 100 km² meets the threshold for Critically Endangered based on geographic range. An AOO of >10 km² and <500 km² meets the threshold for Endangered.

In addition to these thresholds, at least two of three other conditions must be met. These conditions are:

- a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: Met for severely fragmented.

Justification: Using the definition in the IUCN Guidelines (2017), “A taxon can be considered to be severely fragmented if most (>50%) of its total area of occupancy is in habitat patches that are (1) smaller than would be required to support a viable population, and (2) separated from other habitat patches by a large distance.”

The distance of 40 km between the two populations at Gundagai and Goobarragandra River is too great for dispersal if one of the populations is lost. The long-term viability of the Gundagai site is somewhat uncertain, given its private land tenure, small size and the impact of disturbance and weeds and the need for ongoing management. The Goobarragandra population consists of patches of plants occurring along a stretch of the river for several kilometres. Whilst 75% (or three (2km x 2km) grid squares) of the AOO covers the Goobarragandra population, there is evidence to suggest that not all of this AOO consists of viable patches and that some of the patches are separated by a distance that is limiting the possibility of dispersal should a patch be lost. In addition, some habitat patches may be too small to support a long-term viable population. Overall, on a precautionary basis, *Grevillea wilkinsonii* is considered to be severely fragmented.

There are 2 locations (as defined by IUCN 2017) for *Grevillea wilkinsonii* based on the main threats of flood damage at the Goobarragandra population and disturbance at the Gundagai population.

NSW Threatened Species Scientific Committee

- b) Continuing decline observed, estimated, inferred or projected in any of:
(i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals.

Assessment Outcome: met for (iii) area, extent and/or quality of habitat, and (v) number of mature individuals.

Justification: There has been an observed continuing decline in the number of mature individuals in the naturally occurring sites and continuing decline in habitat quality largely due to major flooding events and other habitat disturbances such as the negative effects of stock grazing and competition with other shrubs and grasses (both native and exotic).

- c) Extreme fluctuations.

Assessment Outcome: Data Deficient

Justification: There is currently no documented evidence of extreme fluctuations in the species.

Criterion C Small population size and decline

Assessment Outcome: Taking the lower bound for plant numbers, *Grevillea wilkinsonii* is Critically Endangered via C2a(ii). Using the upper bound, the outcome is Endangered via C2a(ii) if all mature plants (including translocated individuals) are included in the assessment.

Justification: The total number of mature *Grevillea wilkinsonii* plants is likely to be somewhere between 105 and 547. It is not yet clear how many of the translocated individuals will qualify as 'self-sustaining and viable' (see definition in IUCN 2017) and hence can be included in the count for 'mature individuals'. If only the naturally occurring sites are included in the count, there would be 105 mature individuals (97 from Goobarragandra and 8 from Gundagai). If all adult plants in translocated sites are also included, then there would be 547 (539 from Goobarragandra (excluding translocations in 2013 which are known to be too young to be established and self-sustaining) and 8 from Gundagai) (Taws 2018). The most likely number of mature plants lies somewhere between these upper and lower bounds. These figures fit within the bounds for Critically Endangered (if the number of mature individuals is <250), or Endangered (if mature individuals is >250 and <2500) under this criterion (IUCN 2012).

At least one of two additional conditions must be met. These are:

- C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CE); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data Deficient.

Justification: There has been observed decline in the number of mature individuals at the natural sites of *Grevillea wilkinsonii* along the Goobarragandra River due to degradation of the habitat and severe flooding events. When looking at plant numbers alone, this decline has been offset by the addition of translocated *G. wilkinsonii*.

NSW Threatened Species Scientific Committee

However, it is unclear how many translocated individuals have become established and produced viable offspring in line with the IUCN (2017) Guidelines which state that individuals re-introduced within the natural range of the species should be included in the estimate of population size if at least five years have passed since the introduction, and the introduced plants have produced viable offspring. Hence, data is currently not available to quantify continuing decline under C1.

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Subcriterion met

Justification: There has been observable decline in the natural population of *Grevillea wilkinsonii* along the Goobarragandra River due to degradation of the habitat and severe flooding events. Three sites along the river have been lost following the 2012 flood. Future decline is inferred in a number of the translocation sites due to ongoing weed problems, particularly the establishment of exotic grasses that are inhibiting *G. wilkinsonii* recruitment. Whilst two translocation sites have shown an increase in overall plant numbers, the number of mature individuals (as defined in IUCN 2017) in these sites is unclear.

In addition, at least 1 of the following 3 conditions must be met:

a (i). Number of mature individuals in each subpopulation ≤ 50 (CR); ≤ 250 (EN) or ≤ 1000 (VU).

Assessment Outcome: met at Endangered threshold for lower bound and Vulnerable for upper bound.

Justification: C2(a)(i) is met for Endangered for the natural part of the population of *G. wilkinsonii*, but Vulnerable when all translocation sites are included. The Goobarragandra population is the largest with the total number of mature *G. wilkinsonii* plants likely to be somewhere between 97 and 539. However, it is not clear how many translocated individuals qualify as 'self-sustaining and viable' (see definition in IUCN 2017) and hence can be included in the count for 'mature individuals'. If only the naturally occurring sites are included, the number of mature individuals is 97 and C2(a)(i) would be met for Endangered (≤ 250). If all plants in the adult size category are included (natural and translocation sites), there would be 539 individuals (excluding translocated individuals planted in 2013 which are known to be too young to be established and self-sustaining) (Taws 2018) and C2(a)(i) would be met for Vulnerable (≤ 1000).

OR

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: If the number of mature individuals is considered to meet Critically Endangered (< 250) for Criterion C then C2(a)(ii) is met for Critically Endangered as there are at least 90% of mature individuals in the one population. If the number of mature individuals is considered to meet the threshold for Endangered (> 250 but < 2500), then C2(a)(ii) is met for Endangered as there are at least 95% of mature individuals in the one population.

NSW Threatened Species Scientific Committee

Justification: Using the lower bound numbers, there are 105 mature individuals in total (97 from Goobarragandra and 8 from Gundagai), hence the Goobarragandra population contains 92% of the total. Using the upper bound of 547 mature individuals (539 from Goobarragandra and 8 from Gundagai), the Goobarragandra population contains 99% of the total.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient.

Justification: There is currently no documented evidence of extreme fluctuations in the species.

Criterion D Very small or restricted population

Assessment Outcome: Taking the lower bound for plant numbers, *Grevillea wilkinsonii* is Endangered via Criterion D. Using the upper bound, the outcome is Vulnerable if all mature plants (including planted ones) are included in the assessment.

Justification: The thresholds for the number of mature individuals under Criterion D are: <50 (CR), <250 (E), or <1000 (VU) mature individuals. Using the lower bound (natural sites only), the number of mature individuals of *Grevillea wilkinsonii* is <250 (97 Goobarragandra, 8 Gundagai). Using the upper bound, there are estimated to be >250, but <1000 mature individuals (539 Goobarragandra, 8 Gundagai) including both translocation (prior to 2013) and natural sites.

D2. Restricted area of occupancy (typically <20 km²) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: Vulnerable via D2

Justification: *Grevillea wilkinsonii* is “prone to the effects of human activities or stochastic events within a very short time period in an uncertain future and is thus capable of becoming Critically Endangered or even extinct on a very short time period” (IUCN 2012). The AOO is < 20 km², there are only 2 locations and there are ongoing threats at both locations.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: There is insufficient data for quantitative analysis at this point in time.

Conservation and Management Actions

The following sources are available for conservation and management actions for *Grevillea wilkinsonii*:

- NSW Office of Environment and Heritage ‘Saving Our Species’ program for *Grevillea wilkinsonii* (OEH SoS 2019).
- Commonwealth Department of the Environment: *Grevillea wilkinsonii* in Species Profile and Threats Database (DOE 2019).

NSW Threatened Species Scientific Committee

- The surveys of the Tumut Grevillea by Taws (Taws 2011, Taws 2013, Taws 2018).
- The OEH species profile for the Tumut Grevillea (OEH 2018).

Habitat loss, disturbance and modification

- Prevent disturbance by installing new fences where required and retaining and maintaining existing fences so they are stock-proof.
- Minimise impacts of competing native and introduced species.

Invasive species

- Identify and remove/control weeds using physical and/or chemical removal.
- Minimise adverse impacts of cattle grazing and limit cattle access to all known sites.

Ex situ conservation

- Develop a seed collection program for *ex situ* seed banking. Undertake seed collection for long term *ex situ* storage and for use in propagating plants for the translocation program.
- Continue current translocation program. Continue maintenance of the populations until they are viable and able to persist for long periods without intensive management.

Stakeholder Management

- Inform land-owners and managers of sites and establish informal agreements with the landholders to protect the species by permitting the implementation of the ongoing conservation program by the NSW Department of Planning, Industry and Environment.
- Inform land-owners and managers of the adverse impacts of herbicide spraying in the vicinity of *G. wilkinsonii* plants.

Survey and Monitoring priorities

- Monitoring for increased habitat degradation. Monitor weed infestations at affected sites and control when necessary, especially willow, poplar and blackberry. Monitor for evidence of browsing or broken branches and/or disturbance such as presence of dung, and stock hoof prints.
- Regular surveys to determine whether there is a decline in the population. General assessment of recruitment and planting survival annually. Monitor survival and growth of tagged individuals. More detailed monitoring every five years or whenever a major flooding event occurs, using size class method from previous surveys.

Information and Research priorities

- Investigate key factors of the species' life history including recruitment, seed bank dynamics, seedling and adult survival, plant growth, pollination, breeding system, seed predation, dispersal.
- Investigate impact of severe disturbances on species persistence, eg. floods.

NSW Threatened Species Scientific Committee

References

- Auld DT and Denham AJ (1999) The role of ants and mammals in dispersal and post-dispersal seed predation of the shrubs *Grevillea* (Proteaceae). *Plant Ecology* **144**, 201–213.
- Australian Plant Census (n.d.) Centre for Australian National Biodiversity Research, Council of Heads of Australasian Herbaria, IBIS database, viewed 2018, <http://www.anbg.gov.au/chah/apc/index.html>
- Briggs J and Hunter D (2018) Population enhancement plantings help save the Tumut grevillea. In 'Recovering Australian Threatened Species – A Book of Hope'. (Eds S Garnett, P Latch, D Lindenmayer, J Woinarski) pp. 202-210. (CSIRO Publishing: Clayton South, Victoria, Australia)
- DOE (Department of the Environment) (n.d.) *Grevillea wilkinsonii* – Tumut Grevillea in Species Profile and Threats Database, Department of the Environment, Canberra. <http://www.environment.gov.au/sprat> (accessed 07/05/2019)
- IUCN (2012) IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.
- IUCN Standards and Petitions Subcommittee (2017) Guidelines for Using the IUCN Red List Categories and Criteria. Version 13 Prepared by the Standards and Petitions Subcommittee. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- Hunter D and Taws N (2009) Brief Report on Surveys and Monitoring for the Tumut Grevillea (*Grevillea wilkinsonii*): 2008. Unpublished report prepared for the NSW Department of Environment, Climate Change and Water.
- Makinson RO (1993) *Grevillea wilkinsonii* (Proteaceae) a new species from southern New South Wales. *Telopea* **5**, 351-358.
- NSW NPWS (National Park and Wildlife Service) (2001) Recovery plan for the Tumut Grevillea (*Grevillea wilkinsonii*). Hurstville: NSW NPWS.
- NSW Threatened Species Scientific Committee (2018) Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016. Version 2.0 <https://www.environment.nsw.gov.au/resources/threatenedspecies/1AGuidelines20180302.pdf>
- OEH (Office of Environment and Heritage) n.d. Saving our Species internal database, restricted access. (accessed March 2019)

NSW Threatened Species Scientific Committee

OEH (Office of Environment and Heritage) 2018. Tumut Grevillea Profile. Last updated 17th August 2018. Accessed online:

<https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10381>

PlantNet (n.d.) New South Wales Flora Online: *Grevillea wilkinsonii* Makinson <http://plantnet.rbgsyd.nsw.gov.au/cgi-bin/NSWfl.pl?page=nswfl&lvl=sp&name=Grevillea~wilkinsonii> (Accessed 26th March 2019)

Taws N (2011) Survey of Tumut Grevillea (*Grevillea wilkinsonii*) after floods in 2010. Unpublished report prepared by Greening Australia (Capital Region) for NSW Office of Environment and Heritage.

Taws N (2013) Survey of Tumut Grevillea (*Grevillea wilkinsonii*) after record flood heights in 2012. Unpublished report prepared by Greening Australia (Capital Region) for NSW Office of Environment and Heritage.

Taws N (2018) Survey of Tumut Grevillea (*Grevillea wilkinsonii*) in 2017. Unpublished report prepared for the NSW Office of Environment and Heritage.

Timbal B *et al.* (2015) Murray Basin Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports (Eds. Ekström, M. *et al.*) CSIRO and Bureau of Meteorology, Australia

Westman A (n.d.) Comparing genetic diversity of wild and ex situ populations of the endangered shrub *Grevillea wilkinsonii* (Proteaceae) to inform recovery and future ex situ collection efforts. Unpublished report.

Expert Communications

John Briggs - Head, Flora & Vegetation Management Unit, Ecosystems and Threatened Species Team, Conservation and Regional Delivery - South East Region. NSW Department of Planning, Industry and Environment, Queanbeyan.

Bob Makinson – Senior Scientist Threatened Species Risk Assessment. NSW Department of Planning, Industry and Environment, Hurstville.

NSW Threatened Species Scientific Committee

Assessment against BC Act criteria

Overall Assessment Outcome (Clause(s) with the highest category of threat)

Critically Endangered under Clause 4.3(a)(d)(e i, iii) and Critically Endangered under Clause 4.4(a)(e)(i)(ii)(B)

Clause 4.2 – Reduction in population size of species

(Equivalent to IUCN criterion A)

Assessment Outcome: Data Deficient

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 - Restricted geographic distribution of species and other conditions
(Equivalent to IUCN criterion B)

Assessment Outcome: Critically Endangered under Clause 4.3 (a) (d) (e i iii).

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,

NSW Threatened Species Scientific Committee

	(ii)	the geographic distribution of the species,
	(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)

Assessment Outcome: Critically Endangered under Clause 4.4 (a) (e i, ii B)

The estimated total number of mature individuals of the species is:					
	(a)	for critically endangered species	very low, or		
	(b)	for endangered species	low, or		
	(c)	for vulnerable species	moderately low,		
and either of the following 2 conditions apply:					
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):			
		(i)	for critically endangered species	very large, or	
		(ii)	for endangered species	large, or	
		(iii)	for vulnerable species	moderate,	
	(e)	both of the following apply:			
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and		
		(ii)	at least one of the following applies:		
		(A)	the number of individuals in each population of the species is:		
			(I)	for critically endangered species	extremely low, or
			(II)	for endangered species	very low, or
			(III)	for vulnerable species	low,
		(B)	all or nearly all mature individuals of the species occur within one population,		
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.		

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)

Assessment Outcome: Endangered under Clause 4.5 (b)

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

NSW Threatened Species Scientific Committee

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data Deficient

The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species—vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable under Clause 4.7.

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
-------------------------	--