

NSW Threatened Species Scientific Committee

Conservation Assessment of *Grevillea renwickiana* F.Muell. (Proteaceae)

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Grevillea renwickiana F.Muell. (Proteaceae)

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act and EPBC Act: Endangered

The NSW Threatened Species Scientific Committee published a notice of final determination for *Grevillea renwickiana* in 2002 (NSW Scientific Committee 2002). This Conservation Assessment report has found that there is no change to the listing status of this taxon on the schedules of the *Biodiversity Conservation Act 2016*. This report provides an updated assessment for the risk of extinction for the taxon against the criteria in the *Biodiversity Conservation Regulation 2017* using the Common Assessment Method. The Common Assessment Method is the agreed method for assessing the extinction risk of species by the Australian Government and all state and territory governments. This document should be read in conjunction with the 2002 final determination.

Summary of Conservation Assessment

Grevillea renwickiana F.Muell. was found to be eligible for listing as Endangered under Criterion B1ab(iii,v)+2ab(iii,v).

The main reasons for this species being eligible are 1) it has a highly restricted geographic distribution with an estimated extent of occurrence (EOO) of 118 km² and an estimated area of occupancy (AOO) of 52 km²; 2) the species is considered severely fragmented on the basis of its clonal, asexual life history, poor genetic diversity, and low dispersal ability; 3) the species has 2–5 threat-defined locations based on the most serious plausible threat of increasing fire frequency and its coincidence with disease, herbivory, or unsuitable rainfall, which may give rise to “resprouting exhaustion syndrome”; and 4) continuing declines in the area, extent and quality of habitat, as well as the number of mature individuals, are inferred on the basis of increasing fire frequency and climate change driven shifts away from the environmental conditions that have allowed the species to persist.



Grevillea renwickiana, Morton National Park. Credit: Gavan McCarthy/NSW DCCEEW.

Description and Taxonomy

Grevillea renwickiana F.Muell. (Nerriga grevillea, family Proteaceae; PlantNET 2024; CHAH 2024) is described by Makinson (2000) as a “prostrate, root-suckering shrub to 20 cm high; ramets to 1 m across; clonal units to ?30 m across. Leaves usually narrowly ovate to narrowly oblong in gross outline, (2.5–) 6–14 cm long, 15–75 mm wide, pinnatifid to pinnatipartite or sometimes serrato-dentate, with 5–18 teeth or lobes, these usually entire or the lowermost 2- or 3-toothed; ultimate teeth or lobes triangular to oblong, 0.5–3.5 cm long, 5–15 mm wide, pungent; margins recurved to shortly revolute; lower surface loosely subsericeous or with a sparse appressed indumentum. Unit conflorescence erect to slightly curved, secund; floral rachis 20–25 mm long. Flower colour: perianth greenish in late bud, becoming cream to pale pink with a purplish limb; style cream becoming pink to reddish with a green tip. Perianth loosely subsericeous outside. Pistil 26–30.5 mm long (flowers often digynous to polygynous); ovary stipitate; style glabrous. Fruit and seed apparently not produced.”

Distribution and Abundance

The New South Wales (NSW) Scientific Committee (2002) stated that “The species [*Grevillea renwickiana*] is a NSW endemic restricted to six [sub]populations between Nerriga and Charleys Forest on the Southern Tablelands.” and that “The total number of individuals, while difficult to estimate due to the rhizomatous and prostrate habit of the species, is estimated to be between 3,000 and 5,000. Three of six [sub]populations, containing approximately 75% of all individuals, occur within Morton National Park, with the remainder occurring on private property and along road-verges.”

Grevillea renwickiana is endemic to NSW, occurring only on the eastern edges of the tableland plateau west of Endrick and the Budawang Mountains. Since the species was listed as Endangered under the NSW *Threatened Species Conservation Act 1995* in 2002, fewer than 20 new records of the species have been made and many of these are from previously known subpopulations. In total the current known distribution of the species is unchanged from the description provided by the NSW Scientific

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Committee in 2002. Spanning 31 km north to south from Nerriga to Charleys Forest, with the westernmost subpopulations occurring just east of the Mongarlowe River and the easternmost occurrence WNW of Round Mountain in Morton National Park. The major concentrations of the species occur along Nerriga Road at Corang, with more records on Charleys Forest Road towards Mongarlowe. There are smaller patches of records clustered around the westernmost stretches of the Corang River in Morton National Park and southeast of Nerriga on private property and in Morton National Park.

Extent of occurrence and area of occupancy

The current known distribution of *Grevillea renwickiana* is highly restricted with the extent of occurrence (EOO) estimated to be 118 km² and an estimated area of occupancy (AOO) of 52 km². The EOO is based on a minimum convex polygon enclosing all mapped occurrences of the species, and AOO is based on 2 x 2 km grid cells, the methods of assessment recommended by IUCN (2024). Occurrences used for these estimates were retrieved from BioNet (NSW Government 2024) and the Atlas of Living Australia (2024) and excluded erroneous records or those considered no longer extant (K. McDougall pers. comm. June 2024).

Population size

The abundance of *Grevillea renwickiana* is unknown. The species is clonal and comprised of at least eight genetic individuals (genets; James and McDougall 2014). There have been no recent targeted counts of stems (*i.e.*, ramets) across the known subpopulations. However, James and McDougall (2014) suggest that the estimate in the 2002 listing of the species (3,000–5,000 stems; NSW Scientific Committee 2002) is low and that the true number of ramets is likely greater than this estimate. Given this, the upper bound of the past estimate (5,000 stems) is taken as a precautionary lower bound estimate of the current population size. An upper bound estimate of 10,000 individual stems is also currently deemed plausible (NSW DCCEEW 2025). This upper bound is plausible given at least one subpopulation has been observed to occur across ~30 ha, with plants often found only metres from each other (James and McDougall 2014), and much of the private land in the region retains potential habitat that may not have been adequately surveyed and possibly harbours previously unrecorded ramets. On private land within 10 km of known *G. renwickiana* records, within the Bungonia subregion alone (Commonwealth DCCEEW 2024), more than ~12,000 ha of two of the plant community types (PCTs) this species is associated with is predicted to occur: 'Bungonia Tableland Scribbly Gum Shrub Forest' (PCT 3737), and 'Southern Escarpment Montane Heath' (PCT 3869) (NSW DCCEEW 2022; NSW OEH 2024). Moreover, *G. renwickiana* may also occur in other PCTs across its range.

Subpopulations

There are 11–17 subpopulations of *Grevillea renwickiana* based on the IUCN (2024) definition, depending on the degree of connectivity between occurrences, which is uncertain. Given that there is no known gene flow between individuals, the degree of connectivity for this species is based on their physical spread. Although at least one subpopulation is comprised of two genets (James and McDougall 2014), it is expected that *G. renwickiana* has more subpopulations than genets because previously expansive subpopulations comprised of a single genet can become fragmented resulting in two or more subpopulations with the same genetic identity but no physical connection.

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The southernmost set of spatially valid records at Charleys Forest Road are no longer extant; the remaining occurrences in this area are comprised of the records around Nettletons Creek (K. McDougall pers. comm. June 2024). It remains possible that further occurrences of *Grevillea renwickiana* exist in Morton National Park or on adjacent private property. However, the existence of a number of popular walking tracks in this region, and the limited number of additional observations of the species in the 21 years since it was first listed as Endangered, suggest that the current distribution is broadly representative.

Cultural Significance

Grevillea renwickiana occurs on the traditional lands of the Yuin Nation (Native Land Digital 2024). This assessment is not intended to be comprehensive of the traditional ecological knowledge that exists for *Grevillea renwickiana*, or to speak for Aboriginal people. Aboriginal people have a long history of biocultural knowledge, which comes from observing and being on Country, and evolves as it is tested, validated, and passed through generations (Woodward *et al.* 2020). Aboriginal peoples have cared for Country for tens of thousands of years (Bowler *et al.* 2003; Clarkson *et al.* 2017). Although no specific information could be collected on *G. renwickiana*, it is acknowledged that traditional ecological knowledge exists for all plants, animals and fungi connected within the kinship system (Woodward *et al.* 2020).

Ecology

The life history of *Grevillea renwickiana* is not well documented. The species is clonal and has never been observed to sexually reproduce (James and McDougall 2014). Flowers are rarely produced and have been observed in late spring or early summer but appear to abort before reaching maturity and setting fruit (James and McDougall 2014). The species persists by spreading vegetatively via rhizomes with new genetically identical stems shooting from them periodically (James and McDougall 2014). Observations from *ex situ* collections at the Australian National Botanic Gardens suggest the species is long lived once established, but slow to grow and spread, with plants only spreading a few metres over the span of several years (McAuliffe 2020). Spreading in this manner, the species tends to form mats of up to 35 m by 30 m (according to field notes on collection records), comprised of multiple ramets.

As *Grevillea renwickiana* does not appear to reproduce sexually, there is assumed to be no seed bank, and dispersal is limited to the rate of vegetative spread. An additional consequence is that there is no genetic transfer or connectivity between subpopulations. Genetic analysis (James and McDougall 2014) supports the idea that the species is a sterile shrub reliant on asexual reproduction. This analysis also indicates that the genetic diversity measured between subpopulations is likely to have arisen through somatic (non-reproductive) cell mutations with vegetative suckering (James and McDougall 2014). Generation length is unknown.

Based on field observations following the 2019–2020 fires, *Grevillea renwickiana* responds to disturbances such as fire by resprouting from rhizomes. The lack of sexual reproduction means there is no primary or secondary juvenile period for the species *per se*. The age or size at which a vegetative clone becomes resilient to fire and other disturbances is unknown as even apparently small aboveground stems have been

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observed shooting from well-developed, woody rhizomes several centimetres underground (G. Phillips pers. obs. February 2016). Plants have also been observed to return to pre-fire cover levels within 18 months following low intensity, controlled fires (K. McDougall pers. comm. June 2024), and to have been resprouting vigorously from rhizomes within two years following severe fire in 2019 (G. Phillips pers. obs. December 2021; NSW Government 2024). It is therefore likely that fire resistance is dependent on the age/size and depth of the underground rhizomes, and is difficult to elicit from the apparent age or size of aboveground stems.

The habitat of *Grevillea renwickiana* is described as "... open dry sclerophyll forest in sandy, loamy, or clay soils." (Makinson 2000). The dry sclerophyll forests within which the species is commonly associated falls into two main vegetation classes, South East Dry Sclerophyll Forests and Southern Tableland Dry Sclerophyll Forests (Keith 2004). During collections for genetic testing, the species was observed to be "confined to deep sand areas between rock ridges" (J. McAuliffe in Atlas of Living Australia 2024). Associated species in herbarium collection notes include *Eucalyptus mannifera*, *E. dives*, *E. radiata*, *E. viminalis*, *Banksia spinulosa*, *Acacia decurrens*, *Allocasuarina nana*, *Goodenia hederacea*, and *Kunzea ambigua*.

Threats

The NSW Scientific Committee (2002) state that "The existing [sub]populations [of *Grevillea renwickiana*] are highly fragmented due to previous clearing of habitat for agriculture. The [sub]populations on private property and along road verges are threatened by further clearing and all [sub]populations are potentially threatened by inappropriate fire regimes. The species is also threatened by fire control activities."

Clonality, low genetic diversity and fragmentation

An analysis of the genetic structure of *Grevillea renwickiana* indicated that there are eight individual genets (James and McDougall 2014). The authors highlight that the genetic richness is very low, even for a clonal species and that clonality appears to have been the sole mode of reproduction for potentially thousands of years (James and McDougall 2014).

All threats to *Grevillea renwickiana* must be considered in light of its clonality and inability to reproduce sexually. While clonality is a viable strategy for many species, it is most often beneficial under stable and favourable conditions and clonal species are typically less resilient to both disturbances and pathogens (Honnay and Bossuyt 2005). Additionally, it renders the possibility of escaping unfavourable conditions and disturbances via dispersal highly unlikely, if not impossible, as dispersal is limited to the rate of vegetative spread. The limited dispersal ability and fragmented nature of *G. renwickiana* subpopulations also mean that the possibility of subpopulations being recolonised following local extinction is vanishingly small.

Fire

Fire history mapping for the area occupied by *Grevillea renwickiana* is sparse historically, however, 86% of records occur in areas which have been burned at least once since 1980 while the remainder are either long unburned (~60 years) or have no fires recorded (NSW DPIE 2024). Of the records that have been burned, only four

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have been burned more than once, first by a prescribed burn in 2018 and then again in 2019 by the Charleys Forest wildfire (NSW DPIE 2024). Approximately two thirds of all records were affected by the 2019–2020 fires (NSW DPIE 2024).

Many of the *Grevillea renwickiana* records affected by the 2019–2020 fires burnt at extreme severity, including much of the northern half of the species' range (Gibson *et al.* 2020). However, plants were observed to be recovering well, presumably resprouting from rhizomes protected below the soil, within two years of these fires (G. Phillips pers. obs. December 2021; NSW Government 2024), suggesting the species is quite resilient to severe fires.

While *Grevillea renwickiana* appears resilient to severe fires, there may be risks associated with high frequency fires that deplete the species' energy stores for resprouting (Fairman *et al.* 2019; DAWE 2022) or via interactions with other threats occurring pre- or post-fire (Auld *et al.* 2022; DAWE 2022) such as disease, herbivory, or changed rainfall driven by climate change (Karavani *et al.* 2018; Nolan *et al.* 2021; AdaptNSW 2022). The phenomenon in which increasing fire frequency and coincidence with other disturbances causes a plant to reach the limit of its resprouting capacity is known as "resprouting exhaustion syndrome" and may be attributed to depletions in carbohydrate reserves, altered soil nutrients, or hydraulic limitations due to xylem cavitation (Karavani *et al.* 2018; Nolan *et al.* 2021). The dry sclerophyll forests within which the species is commonly associated both appear to be under increasing pressure from high frequency fire, experiencing a 28-51% increase in the area burned too frequently following the 2019–2020 fires (Le Breton *et al.* 2022). Overall fire intervals are shrinking, and fire frequency is increasing across the species range (Le Breton *et al.* 2022). Changes in climate are also contributing to changes in the fire regime (see below).

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*. 'Fire regimes that cause declines in biodiversity' is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Land clearing and mechanical disturbance

The region in which *Grevillea renwickiana* occurs has been subject to substantial historical land clearing, which has likely contributed to the current fragmented distribution of the species. Around half of the species' records and subpopulations are reserved in Morton National Park, while the other half occur on private property or road verges and consequently may be at risk of land clearing or mechanical disturbance for agricultural or bushfire prevention purposes. In Morton National Park, individual *G. renwickiana* stems may be at risk from damage or disturbance by recreational land use. While protections are in place for land use on private property and on road verges where the species occurs, they rely on the co-operation of landholders and the knowledge of the species' occurrence where clearing is proposed. A number of records occur along roads and have been adversely affected by contractors and roadworks including the clearance of aboveground stems during road widening works (G. Phillips pers. obs. February 2016; K. McDougall pers. comm. June 2024).

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‘Clearing of native vegetation’ is listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*. ‘Land clearance’ is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Disease

Studies of the impacts of *Phytophthora cinnamomi* on *Grevillea renwickiana* in lab conditions found no significant negative effects on infected plants (Wan *et al.* 2019). While the extinction risk imposed by *P. cinnamomi* on *G. renwickiana* has been classified as low (McDougall *et al.* 2024) there remains a possibility of negative effects under different conditions in the species natural habitat or via interactions with other threats.

‘Infection of native plants by *Phytophthora cinnamomi*’ is listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*. ‘Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)’ is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Changing abiotic conditions and increasing fire frequency as a result of climate change

Climate change is driving a range of environmental shifts across the range of *Grevillea renwickiana*. Average maximum temperature in summer is projected to increase by up to 1°C in the near future (2020–2039), and weather events conducive to fire are projected to increase, particularly in spring and summer (AdaptNSW 2022). Rainfall is expected to decrease over winter and spring, and increase in summer and Autumn (AdaptNSW 2022). The combined effects of decreased winter and spring rainfall, increased temperatures and increased fire weather across spring and summer suggest that fire frequency may increase due to drier, hotter conditions leading into the fire season than has historically been the case. Droughts are also expected to occur more frequently and more severely, however, resprouters are typically resilient to drought (Zeppel *et al.* 2015).

Grevillea renwickiana lacks sexual reproduction and has extremely limited genetic diversity and dispersal ability, meaning that it has essentially no capacity to adapt to shifts in abiotic conditions and disturbance regimes driven by climate change.

‘Anthropogenic Climate Change’ is listed as a Key Threatening Process under the NSW *Biodiversity Conservation Act 2016*. ‘Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases’ is listed as a Key Threatening Process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Invasive herbivores

Feral herbivores are widespread across the range of *Grevillea renwickiana*. Feral deer (*Cervus* spp.), feral goats (*Capra hircus*), and feral pigs (*Sus scrofa*), along with feral or domestic sheep (*Ovis aries*) and cattle (*Bos taurus*), are known to be present in Morton National Park (NPWS 2001). Observations of damage by pigs are mentioned in collection notes from records made in 2022 (NSW Government 2024).

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The adverse effects of feral herbivores on *Grevillea renwickiana* are uncertain, though it may compound the effects of other threats if new shoots are eaten or disturbed, particularly if the species is also affected by fire and disease (Auld *et al.* 2022).

‘Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758’, ‘Herbivory and environmental degradation caused by feral deer’, and ‘Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758’ are listed as Key Threatening Processes under the NSW *Biodiversity Conservation Act 2016*.

‘Competition and land degradation by unmanaged goats’, ‘Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs’, and ‘Novel biota and their impact on biodiversity’ are listed as Key Threatening Processes under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threat-defined Locations

Grevillea renwickiana is assessed as having 2–5 threat-defined locations based on the most serious plausible threat of increasing fire frequency and its coincidence with disease, herbivory, or unsuitable rainfall, which may give rise to “resprouting exhaustion syndrome” (Karavani *et al.* 2018; Nolan *et al.* 2021). Although the 2019–20 fires have shown that very large areas can be burnt, it is considered unlikely that the entire species’ range would be subject to the same frequency of fire, so a minimum of two threat-defined locations is estimated. The occurrence of most of the northern subpopulations in mostly continuous bushland suggests that there may be as few as one location here that may be subject to frequent widespread wildfire. The records in the south of the species’ range may be considered as one threat-defined location or constitute up to four locations because they are more fragmented by cleared farmland. Anthropogenic fire management is expected to produce more spatially and temporally variable fire regimes in this area.

Assessment against IUCN Red List criteria

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

Criterion A *Population Size reduction*

Assessment Outcome: Data Deficient.

Justification: While it is highly likely that *Grevillea renwickiana* has undergone historical declines in the number of ramets (and possibly genets) due to land clearing, the past distribution is unknown. Additionally, generation length is unknown and there is not enough data to quantify future decline.

Criterion B *Geographic range*

Assessment Outcome: Endangered under Criterion B1ab(iii,v)+2ab(iii,v)

Justification: Estimates of the current known distribution of *Grevillea renwickiana* suggest it is highly restricted with an extent of occurrence (EOO) of 118 km² and an area of occupancy (AOO) of 52 km², based on a minimum convex polygon fitted to known records and 2 x 2 km grids, respectively, as per IUCN (2024). The estimated

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EOO and AOO for *Grevillea renwickiana* meet the thresholds for Endangered (<5,000 km² and <500 km² respectively).

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 Endangered with ≤5 threat-defined locations and severe fragmentation.

Justification: *Grevillea renwickiana* is considered severely fragmented based on:

1) An absence of genetic connectivity between subpopulations and dispersal being limited to the rate of vegetative spread via suckering. Vegetative spread has been observed to be very low and even relatively close subpopulations (c. 1 km) are unlikely to be recolonised naturally should one be lost.

2) For a species to be considered severely fragmented >50% of individuals must occur in patches too small to support a viable population. Population viability relates to the number of genetic individuals/genets required to support a self-sustaining, genetically viable population. Being a species with presumably limited capacity to exchange genetic material between genets for hundreds or thousands of years and with most subpopulations consisting of a single genet (James and McDougall 2014), population viability is not an applicable concept in *G. renwickiana*. For a clonal, asexual species such as *G. renwickiana*, persistence depends on environmental stability and the continuation of the conditions to which the existing genets are adapted and able to flourish under. Given the ongoing and increasing effects of climate change and the apparent increase in fire frequency across the species' range, it can be inferred that at least 50% of the species' individuals occur in subpopulations that are not viable. The lack of genetic diversity, inability to disperse and changing climate and fire frequencies all indicate that few if any subpopulations could be considered viable.

Additionally, *Grevillea renwickiana* is assessed as having 2–5 threat-defined locations based on the most serious plausible threat of increasing fire frequency and its coincidence with disease, herbivory, or unsuitable rainfall, which may give rise to “resprouting exhaustion syndrome” (Karavani et al. 2018; Nolan et al. 2021), meeting the threshold for Endangered. Although the 2019–20 fires have shown that very large areas can be burnt, it is considered unlikely that the entire species' range would be subject to the same frequency of fire, so a minimum of two threat-defined locations is expected. The occurrence of most of the northern subpopulations in mostly continuous bushland suggests that there may be as few as one location here that may be subject to frequent widespread wildfire. The records in the south of the species' range may be considered as one threat-defined location or constitute up to four locations because

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they are more fragmented by cleared farmland. Anthropogenic fire management is expected to produce more spatially and temporally variable fire regimes in this area.

- 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: Continuing decline in the area, extent and quality of habitat, and the number of mature individuals is inferred based on the ongoing and increasing negative effects of climate change, past observed effects of roadside clearing and potential for further negative effects, and the apparent increase in fire frequency across the range of *Grevillea renwickiana*. The species lacks sexual reproduction and has extremely limited genetic diversity and dispersal ability, meaning that it may have limited capacity to adapt to shifts in abiotic conditions and disturbance regimes driven by climate change.

- c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: *Grevillea renwickiana* is not known to undergo extreme fluctuations in geographic distribution, number of locations or subpopulations, or population size.

Criterion C Small population size and decline

Assessment Outcome: Data Deficient.

Justification: *Grevillea renwickiana* is estimated to have 5,000–10,000 stems (ramets) across its population, each being a clonal individual capable of reproducing vegetatively, and thus representing a mature individual per IUCN (2024).

Although continuing decline is inferred, none of the required sub-criteria are met due to insufficient data.

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) (CR); 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: The generation length of *Grevillea renwickiana* is unknown and there is insufficient data to estimate or project declines.

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

Assessment Outcome: Met for continuing decline in number of mature individuals.

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Justification: Given the shifts in abiotic conditions and disturbance regimes driven by climate change, and the apparent increase in fire frequency across the range of *Grevillea renwickiana*, continuing decline is inferred in the number of mature individuals.

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

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

Assessment Outcome: Data Deficient.

Justification: The number of mature individuals in each subpopulation of *Grevillea renwickiana* is uncertain, but it is possible that the largest subpopulation, which covers an area of 30 ha or 43% of the known occupied area (James and McDougall 2014), has $>1,000$ mature individuals.

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

Assessment Outcome: Data Deficient.

Justification: The proportion of mature individuals in each subpopulation is unknown. It is plausible that the subpopulation that covers 30 ha contains a substantial proportion of the species' population. However, there is insufficient data to quantify this.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met

Justification: *Grevillea renwickiana* has not been observed to undergo extreme fluctuations in the number of mature individuals, and its life-history of asexual, clonal reproduction via rhizomes would preclude this as a possibility.

Criterion D Very small or restricted population

Assessment Outcome: Not met.

Justification: Based on current knowledge, *Grevillea renwickiana* does not meet the criteria to be listed under Criterion D1 or D2.

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

- D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Not met.

Justification: *Grevillea renwickiana* is estimated to have 5,000–10,000 stems (ramets) across its population, each being a clonal individual capable of reproducing vegetatively, and thus representing a mature individual per IUCN (2024).

- D2. Restricted area of occupancy (typically $<20 \text{ km}^2$) 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.

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Assessment Outcome: Not met.

Justification: *Grevillea renwickiana* has an estimated AOO of 52 km² and 2–5 threat-defined locations. However, none of the threats to this species are expected to drive it to Critically Endangered, or Extinct, within a very short time.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient.

Justification: There is insufficient data to conduct a quantitative analysis on the extinction probability of *Grevillea renwickiana*.

Conservation and Management Actions

Grevillea renwickiana is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation strategy has been developed by the NSW Department of Planning and Environment under the Saving our Species (SoS) program. The conservation strategy identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Grevillea renwickiana* sits within the site-managed species management stream of the SoS program.

There are two priority management sites identified for *Grevillea renwickiana*: Morton National Park and Nettletons Creek. Activities currently recommended by the SoS program (SoS 2018; SoS 2019; SoS 2020; SoS 2021; SoS 2022) to assist the species at these sites include:

Habitat loss, disturbance and modification

- Where subpopulations occur along road edges, erect barriers or establish signage to discourage disturbance by road maintenance or recreational users.
- Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure for subpopulations not already protected.
- Ensure National Parks and Wildlife Service and Rural Fire Service are aware of the locations of subpopulations on the relevant tenures to ensure that appropriate fire management actions are employed in these areas.
- Develop and implement an evidence-based fire management strategy that minimises risks of decline and optimises population persistence for the species.
- Develop biosanitation protocols in accordance with national guidelines (see 'Arrive Clean, Leave Clean' (Commonwealth of Australia 2015)).
- Monitor for any signs of dieback across subpopulations especially following wetter than usual conditions.

Invasive species

- Monitor for the presence of feral herbivores across the range of *Grevillea renwickiana* and undertake actions to reduce their adverse effects including potentially fencing off areas or population reduction measures.

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- Continue efforts to trap and remove feral pigs from key management sites as necessary.
- Monitor and control weeds that may compete with *Grevillea renwickiana*.

Ex situ conservation

- Establish ex situ collections of live plants and propagules as insurance populations from which to establish translocation sites in the future.
- If appropriate, investigate the feasibility of establishing translocated populations that will improve the conservation outlook of *Grevillea renwickiana*. Translocations should be conducted in accordance with best practice guidelines and procedures (refer to Commander 2018), including monitoring translocated populations through to recruitment to ensure they are viable.

Stakeholders

- Inform landowners and managers of sites where there are known subpopulations and consult with these groups regarding options for conservation management and protection of *Grevillea renwickiana*.
- Engage with landholders and nearby communities to raise awareness of the species and its conservation significance.
- Relevant Traditional Owners should be identified and consulted with on all planned recovery actions. Effort should be made to collaborate with Traditional Owner groups in the implementation of any actions.
- Engage cultural knowledge custodians and land rights holders in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions. Enable the sharing of knowledge, while ensuring the processes and protocols to record, store, and share any knowledge are agreed and appropriately resourced. Information on the application of cultural burning and integrated Caring for Country practices to protect and enhance habitat is of critical importance.

Survey and Monitoring priorities

- Monitor for increased habitat degradation.
- Regularly survey to determine whether there is a decline in the population.
- Monitor for impacts of threats including die-back and herbivory.

Information and Research priorities

- Undertake research either experimentally or through opportunistic surveys to establish the fire frequencies and severities that are tolerable for *Grevillea renwickiana* to inform fire management protocols.
- Determine the climatic niche of *Grevillea renwickiana* and investigate how it may respond to predicted climate changes to inform the location of potential future translocation sites.

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APPENDIX 1

Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: *Grevillea renwickiana* was found to be Endangered under Clause 4.3(b)(d)(e i,iii)

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: Endangered under Clause 4.3(b)(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,

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	(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,
	(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: Data Deficient.

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.

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Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Not met.

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.

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: Not met.

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.
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