

Conservation Assessment for *Plinthanthesis rodwayi* (C.E.Hubb) S.T.Blake (family Poaceae)

Tom D. Le Breton¹ and Tony D. Auld¹, 8 November 2018

¹ Science Division, NSW Office of Environment and Heritage

***Plinthanthesis rodwayi* (C.E.Hubb) S.T.Blake (Poaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Vulnerable

Current NSW BC Act Status: Endangered

Proposed BC Act Status: Critically endangered

Conservation Advice: *Plinthanthesis rodwayi*

Summary of Conservation Assessment

Plinthanthesis rodwayi was found to be eligible for listing as Critically Endangered under Criterion B1ab(i, ii, iii, iv, v)+2ab(i, ii, iii, iv, v).

The main reasons for this species being eligible are i) a very highly-restricted distribution, the area of occupancy (AOO) was estimated to be 4 km², measured with a 2 km x 2 km grid as per IUCN Guidelines (IUCN 2017), while the extent of occurrence (EOO) was also found to be 4 km² as IUCN (2017) stipulates that EOO cannot be less than AOO. Both AOO and EOO meet the distribution thresholds for Critically Endangered (<10 km² and <100 km², respectively); ii) there is only a single remaining location at Mt. Budawang as defined by the most serious plausible threat (an absence of fire resulting in habitat dominance by shrubs outcompeting *P. rodwayi*). The species is also considered to be severely fragmented as it is highly isolated with no other populations available to recolonise it in the event of local extinction; iii) continuing declines in EOO, AOO, area, extent and or quality of habitat and number of locations or subpopulations as a result of too long fire intervals, leading to a decline in habitat quality as the vegetation transitioned from an open grassy heathland to a dense shrubland ultimately leading to the loss of the Currockbilly Mountain population. While this decline has technically ceased due to the extinction of one population and recent growth in numbers at the remaining population, the species appears likely to decline again in the future in the absence of fire management.

Description and Taxonomy

The NSW Scientific Committee (2002) state that "*Plinthanthesis rodwayi* (C.E. Hubb.) S.T. Blake (family Poaceae) is described by S. W. L. Jacobs and K. L. McClay (1993) in Harden, G. (ed.). Flora of New South Wales. UNSW Press. Vol. 4. P. 558 as: Caespitose perennial to 0.5 m high. Leaves: ligule a ciliate rim with hairs c. 0.25 mm long; blade linear, rolled, upper surface and margins scabrous, glabrous. Inflorescence open, 6-8 cm long, 2-5 cm wide; rachis slender, usually flexuous, scabrous. Spikelets 5-6 mm long, gaping to 7 mm wide at maturity, bisexual florets 2, sometimes with 1 reduced floret above; pedicels slender, usually flexuous, 2-10 mm long, scabrous. Glumes 4-5 mm long, 3 nerved, keel minutely scabrous, glabrous. Lemmas 3-3.5 mm long, 8-nerved, awnless or with an awn in the sinus, lower half pilose with hairs < 0.25 mm long, margins purplish brown, 2-lobed; lobes < 1 mm long, subulate; awn, when present, slender, < 0.5 mm long. Palea subequal to lemma, 2-keeled, keel scabrous, lower half pilose with hairs < 0.25 mm long. Flowers spring-summer."

Originally described as *Danthonia rodwayi* C. E. Hubb (Hubbard 1943) and later as *Blakeochloa rodwayi* (C. E. Hubb) Veldkamp (Veldkamp 1980), *Plinthanthesis rodwayi* is the currently accepted

taxonomic nomenclature for the species following a review of genera *Plinthanthesis* and *Danthonia* (Blake 1972).

Distribution and Abundance

The NSW Scientific Committee (2002) state that “The species is a NSW endemic which was known from only two mountain tops within Budawang National Park in the 1930s - 1970s. The species has not been relocated at these sites in recent years despite thorough surveys, and despite the species being noted as locally frequent in the late 1970s.”

No new occurrences of *Plinthanthesis rodwayi* have been discovered outside of the original two mountain tops where the species was recorded from (Mt Budawang and Currockbilly Mountain), and a lack of fire has resulted in the vegetation at these sites transitioning from grassland to shrubland (NSWSC 2008). Australia’s National Herbarium contains seven records outside of the known distribution of the species, however, six of these were catalogued with an incorrect location, Tinderry Nature Reserve (K. McDougall, pers. comm. Sep. 2017) and the other, from Morton National Park, is a misidentification of another species of *Plinthanthesis* (K. McDougall pers. comm. Sep. 2017).

In 2004, a single plant was located at Mt. Budawang (NSWSC 2008), and a small herbivore excluding fence was erected around a 25 m x 25 m area, 100 m west of that individual plant, in more open vegetation, and the shrub layer within was removed (NSWSC 2008).

In 2007, surveys of the two mountain tops where *Plinthanthesis rodwayi* had previously been recorded were undertaken (NSW Scientific Committee 2009). The survey identified 25 mature individuals at Mt Budawang, all having emerged within the enclosure, however, no individuals were located at Mt Currockbilly (NSW Scientific Committee 2009). At the time, it was speculated that the species may still be present as inconspicuous non-flowering individuals, or within a soil stored seed bank (NSWSC 2008). However, repeated searches in the past nine years have failed to locate any plants. This includes searches made after a large fire in 2013 which burnt most of the western face of Currockbilly Mountain (prior to the fire, vegetation had become very dense as it had not been burnt since the 1960s [K. McDougall, pers. comm. Sep. 2017]). This population of *P. rodwayi* on Currockbilly Mountain is believed to be extinct (K. McDougall, pers. comm. Sep. 2017). This conclusion is supported by two elements of perennial grass ecology;

- Firstly, in a study of the demography of 11 species of perennial grasses over 40 years in a stable, temperate grassland habitat, observed maximum lifespans of perennial grasses varied from 5 to 39 years, however, mean life expectancy was only 6.5 years (Lauenroth & Adler 2008). While the lifespan of *P. rodwayi* is unknown, generation length is estimated to be 6 to 15 years (NSW Scientific Committee 2009), this is consistent with the findings of the aforementioned study. Consequently, the period which *P. rodwayi* has been undetectable on Currockbilly Mountain, c. 39 years, far exceeds the likely lifespan of the species, and exceeds multiple generations.
- Secondly, many perennial grasses from non arid or semi arid areas do not typically produce long lived seed banks. Often seed banks are transient, with many species having few soil stored seeds viable after 5 years (Baskin & Baskin 1998). There is evidence that some grass species in fire-prone habitats in Australia possess persistent long-lived soil seed banks capable of persisting 10 years or more, however, fire free intervals of greater than 10 to 20 years are speculated to result in local extinctions (Auld *et al.* 2000). The time that has passed since *P. rodwayi* was observed on Currockbilly Mountain is nearly twice the length of the upper bounds of observed grass seed longevity and the time since the last fire is c. 50 years.

There have been no further formal surveys since the identification of 25 individuals in the fenced area in 2007 at Mt Budawang. However, the fenced population has grown to an estimated 200 individuals, then following reduced herbivore pressure in the past year, the population expanded beyond the fence and has increased to c. 300 plants, none of which are believed to be clonal (K. McDougall pers. comm. Sep. 2017).

The entire distribution of the species occurs within Budawang National Park.

Ecology

Little is known about the ecology of *Plinthanthesis rodwayi* outside of habitat and occurrence associations. All records have come from two mountains above 1000 m altitude where the species occurs in shallow soil (NSW Scientific Committee 2009). Mt Budawang and Currockbilly Mountain are unique peaks within the context of the Budawang Range in that they are prominent, being the two highest peaks in the range by some 200 m, but comprised mainly of quartzite, arenite and shale rather than primarily sandstone (OEH 2011). The habitat that *P. rodwayi* grows in has been described as open, montane heathlands on shallow soils (Harden 1993), however, due to a lack of fire the habitat on both Mt Budawang and Currockbilly Mountain has transitioned to dense heath dominated by *Leptospermum* sp. aff. *grandiflorum* with the remaining patches of *P. rodwayi* occurring patches that have been manually cleared of the shrub layer during management activities (K. McDougall, pers. comm. Sep. 2017).

The life history of the *P. rodwayi* is also poorly known, flowering occurs in spring to summer and the species produces ample seed (K. McDougall, pers. comm. Sep. 2017). However, attempts to germinate seeds have so far been unsuccessful and the cues and conditions required for germination remain unknown (K. McDougall, pers. comm. Sep. 2017). In spite of this, the fenced off population on Mt. Budawang is experiencing ongoing recruitment, which is taken as evidence of the production of viable seed as the species is not believed to be propagating via clonal production (K. McDougall, pers. comm. Sep. 2017). The extent to which the species can maintain a persistent soil seed bank is unknown. The fire response is likely similar to many perennial grassland species, resprouting from dormant buds within the soil, with limited post fire recruitment from seed (Lunt & Morgan, 2002). Two of the major impacts of fire on perennial grassland species is the prevention of competitive exclusion by the shrub layer and opening gaps to allow seedling recruitment to occur when conditions are favourable (Morgan 1999). The loss of the Currockbilly Mountain *P. rodwayi* population following a lack of fire for c. 50 years, illustrates the likely importance of fire in this system for the persistence of the species.

Threats

The NSW Scientific Committee (2002) state that “Although the exact cause of [the post 1970s] decline is unknown, proposed causes include; gross change in vegetation structure, grazing by macropods and the absence of fire.”

The main threats to the species at present include:

- inappropriate fire regimes; too long fire intervals resulting in competition from *Leptospermum* sp. aff. *grandiflorum* and likely limiting opportunities for recruitment from seed in the absence of the creation of canopy gaps for recruitment, this has resulted in the loss of the Currockbilly Mountain population;
- grazing pressure from native grazers including macropods and wombats, as well as by rabbits (K. McDougall, pers. comm. Sep. 2017). The impacts of grazing have been reduced over the past ten years due to the erection of an herbivore excluding fence at Mt. Budawang,

and an unrelated, unexplained decline in herbivore pressure outside the fence over the past year has resulted in the populations expansion beyond the fenced area (K. McDougall, pers. comm. Sep. 2017);

- loss of habitat; this threat is a consequence of the long fire-free interval as the habitat has transitioned from “open, montane heathlands” (Harden 1993) to dense heath dominated by *Leptospermum* sp. aff. *grandiflorum*;
- small population size and limited distribution place the species at risk of stochastic events.

Additionally, the telecommunications infrastructure on Mt. Budawang is likely to be extended at some point in the future, and this may negatively impact on the population at that site.

The recent population growth has been due to ongoing active management (i.e. the creation and maintenance of an herbivore proof enclosure), while in the broader context there has been a decline in the number of locations and populations as a result of the loss of the Currockbilly Mountain population. At present, the species may not be self-sustaining in the absence of active conservation management.

At present, conservation management actions include the maintenance of an ex situ population at the Australian National Botanic Gardens, research into germination cues, and initiating the process of identifying and setting up a translocation site on Currockbilly Mountain (K. McDougall, pers. comm. Sep. 2017).

Assessment against IUCN Red List criteria

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

Criterion A Population Size reduction

Assessment Outcome: Endangered under Criterion A2 (c)

Justification: The species is known to have undergone declines over the past 30-40 years. Upper and lower bound estimates can be generated based on population surveys and observations over the last three generations. Generation length is estimated to be between 6 and 15 years, giving a lower bound reduction window of 18 years and an upper bound of 45 years. In 1977/78 *P. rodwayi* was described as rare but locally frequent and occurring in a single patch at Currockbilly Mountain and Mount Budawang respectively. By 2000 no plants could be located at either location despite thorough surveys (NSW Scientific Committee 2002), but the population at Mount Budawang has since returned and grown to c. 300 plants. No plants have been found at Currockbilly Mountain despite numerous additional surveys. No comparative estimates across three generations for population size are available. In terms of Area of occupancy (AOO), there has been a reduction of 0 (lower bound) to 50% (upper bound) as a result of the presumed extinction of the Currockbilly Mountain population. Under the upper bound estimate of generation length of 15 years, *P. rodwayi* would meet Criterion A2 at the Endangered threshold of 50% for a 50% decline in AOO and because the causes of the reduction (inappropriate fire regime) may not have ceased.

Criterion B Geographic range

Assessment Outcome: Critically Endangered under Criterion B1ab(i, ii, iii, iv, v)+2ab(i, ii, iii, iv, v)

Justification: *Plinthanthesis rodwayi* has a very highly-restricted distribution, the area of occupancy (AOO) was estimated to be 4 km², measured with a 2 km x 2 km grid as per IUCN Guidelines (IUCN 2017), while the extent of occurrence (EOO) was also found to be 4 km² as IUCN (2017)

stipulate that EOO cannot be less than AOO. Both AOO and EOO meet the distribution thresholds for Critically Endangered (< 10 km² and < 100 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: Sub criterion met at Critically Endangered Threshold.

Justification: There is only one location (the Mt. Budawang population) as defined by the most serious plausible threat, an absence of fire resulting in habitat dominance by shrubs outcompeting *P. rodwayi*. The species is also considered to be severely fragmented as it is highly isolated with no other populations available to recolonise it in the event of local extinction.

- 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: Sub Criterion met for i,ii,iii, iv, v

Justification: *Plinthanthesis rodwayi* has been observed to experience continuing declines in i) extent of occurrence; ii) area of occupancy; iii) area, extent and or quality of habitat and iv) number of locations or subpopulations and v) number of mature individuals as a result of too long fire intervals, leading to a decline in habitat quality as the vegetation transitioned from an open grassy heathland to a dense shrubland ultimately leading to the loss of the Currockbilly Mountain subpopulation. While there has been recent growth in numbers at the one remaining population, the species appears likely to decline again in the future in the absence of fire and other targeted management activities.

- c) Extreme fluctuations.

Assessment Outcome: Data deficient

Justification: There is insufficient data to assess whether this species experiences extreme fluctuations.

Criterion C Small population size and decline

Assessment Outcome: Endangered under Criterion C2a(ii)

Justification: Current population estimates place the number of mature individuals between 250 and 300, and this meets the threshold for Endangered (< 2500 mature individuals)

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

- C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future).

Assessment Outcome: Data deficient

Justification: Although the species has experienced declines in the past and could again in the future there is insufficient data available to quantify the extent of these declines due to insufficient population data over time, as all population data from prior to 2004 is described in relative terms.

- C2. An observed, estimated, projected or inferred continuing decline

Assessment Outcome: Sub criterion met

Justification: *Plinthanthesis rodwayi* has been observed to experience a continuing decline as a result of too long fire intervals, leading to a decline in habitat quality as the vegetation transitioned from an open grassy heathland to a dense shrubland ultimately leading to the loss of all mature individuals in the Currockbilly Mountain subpopulation and the majority of mature individuals at Mount Budawang with little to no regeneration from the seed bank. While there has been a recent growth in numbers at the remaining

population, the species appears likely to decline again in the future in the absence of targeted management activities.

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

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

Assessment Outcome: Sub criterion met at Vulnerable threshold

Justification: there are believed to be 250 to 300 mature individuals in the remaining population.

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

Assessment Outcome: Sub criterion met at Critically Endangered threshold

Justification: 100% of individuals occur in the one remaining population.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient

Justification: There is insufficient data to assess whether this species experiences extreme fluctuations.

Criterion D Very small or restricted population

Assessment Outcome: Vulnerable under Criterion D and D2

Justification: The current estimate of the number of mature individuals is 250-300, this is greater than the thresholds for CR or EN.

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

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

Assessment Outcome: Sub criterion met at Vulnerable threshold

Justification: Current estimates of the number of mature individuals are between 250-300 plants.

- 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.

Assessment Outcome: Sub criterion met

Justification: There is only a single location for *Plinthanthesis rodwayi* and the AOO is 4 km^2 . Plausible threats which could drive the species to CR or EX in a very short time include, cessation of management activities which at present are keeping the species from being grazed by herbivores and outcompeted by *Leptospermum* sp. aff. *grandiflorum*, a threat which has driven the species to extinction at its only other previously known location.

Criterion E Quantitative Analysis

Assessment Outcome: Data Deficient

Justification: There is insufficient data available to quantify the extinction risk for this species at this time.

Conservation and Management Actions

There is no National Recovery Plan, however, there is a NSW Saving our Species program for this species as well as a Commonwealth Conservation Advice. The following is derived from these documents and the threat information.

Habitat loss, disturbance and modification

- Prevent habitat dominance and outcompeting of *Plinthanthesis rodwayi* by *Leptospermum* sp. aff. *grandiflorum* through manual clearing of the shrub layer around known occurrences of *P. rodwayi*.
- Monitor presence of threats at the Mt. Budawang location, the arrival of threats such as new weed species, maintenance and possible extension of nearby infrastructure, changes in herbivore abundance/activity all have implications for the persistence of the species.
- Expand fence to encompass new recruits outside the fence and maintain the fencing to minimise disturbance and herbivory from native and invasive species.
- If possible, rehabilitate formerly suitable habitat on Currockbilly Mountain, in conjunction with proposed translocation site (see below).
- Exclude prescribed fire from the immediate vicinity of the remaining plants until the germination requirements of the seed and possibly fire response of individual plants is more thoroughly understood, current numbers are too low to risk any error in the implementation of an experimental fire regime.
- Implement small localised burns, if possible, in formerly inhabited areas on both Mt. Budawang and Currockbilly Mountain with the aim of a) returning habitat to a more open structure of the sort conducive to the growth of *P. rodwayi*; and b) to open gaps for the stimulation of germination of any remaining seeds stored within the soil.
- assessment of the impact of the likely extension of the telecommunications infrastructure on Mt. Budawang on the species and the surrounding environment will need to be conducted, and adequate measures will need to be proposed and implemented mitigate the impact of the project, should it proceed.

Invasive species

- Manage and remove weeds where necessary and possible.
- Implement controls, such as shooting, baiting, trapping or further fencing for rabbit populations which are currently inhibiting flowering in the plants occurring outside the enclosure (K. McDougall, pers. comm. Sep. 2017)

Ex situ conservation

- Maintain and enhance the current ex situ population already in place at the Australian National Botanic Gardens, ideally by germinating from seed when that becomes possible (see Research Priorities below).
- Establish translocated population at Currockbilly Mountain if natural recruitment does not occur following experimental burning at the site.

Stakeholder Management

- Ensure that NSW NPWS rangers and the NSW RFS are aware of the location of the Mt. Budawang population and its relevant fire requirements should any fire control activities be scheduled for the area.

- Liaise with relevant planning authorities and stakeholders involved in any potential future extension of telecommunications infrastructure to inform them of the location of the Mt. Budawang population and ensure planning does not negatively impact the species.
- Ensure that appropriate signage and information is in place and available to the public to raise community awareness and discourage damage to the population or the fence around it.

Survey and Monitoring priorities

- Monitoring for increased habitat degradation.
- Regular surveys to determine whether the population is declining or growing.
- Ongoing monitoring for recruitment in any burnt sites on Mt. Budawang and Currockbilly Mountain, as it has been observed that immediate post-fire recruitment may not be significant in perennial grass species but the gaps opened by the fire may facilitate recruitment from the seed bank over time (Lunt & Morgan 2002).

Information and Research priorities

- Further research into germination requirements necessary for ex situ germination from seed.
- Germination requirements of *P. rodwayi* seeds in relation to fire cues.
- Determine the fire response of mature plants.
- Understand the relative impacts of different herbivores and trends in herbivory abundance levels.
- Experimentally examine soil seed bank longevity, in order to help inform maximum fire free intervals that *P. rodwayi* may tolerate.

References

- Auld, T. D., Keith, D. A. & Bradstock, R. A., 2000. Patterns in longevity of soil seedbanks in fire-prone communities of south-eastern Australia. *Australian Journal of Botany*, Vol. 48, pp. 539-548.
- Baskin, C. C. and Baskin, J. M., 1998. "Ecology of seed dormancy and germination in grasses." *Population biology of grasses* pp: 30-83.
- Blake, S.T., 1972. Plinthanthesis and Danthonia and a review of the Australian species of *Leptochloa* (Gramineae). *Contributions from the Queensland Herbarium*, pp.1-19.
- Harden, G., 1990–1993. Flora of New South Wales.
- IUCN Standards and Petitions Subcommittee, 2017. Guidelines for Using the IUCN Red List Categories and Criteria, Version 12.
- IUCN, 2012. IUCN Red List Categories and Criteria: Version 3.1, 2nd ed. Gland, Switzerland and Cambridge, UK.
- Lauenroth, W.K. and Adler, P.B., 2008. Demography of perennial grassland plants: survival, life expectancy and life span. *Journal of Ecology*, 96(5), pp.1023-1032.
- Lunt, I. & Morgan, J. W., 2002. "Grasslands of southeastern Australia." *Flammable Australia: The Fire Regimes and Biodiversity of a Continent*: pp. 177-196.

Morgan, J. W. 1999. "Defining grassland fire events and the response of perennial plants to annual fire in temperate grasslands of south-eastern Australia." *Plant ecology* 144.1 pp: 127-144.

NSW Scientific Committee, 2002. Nomination to upgrade *Plinthanthesis rodwayi* (C. E. Hubb.) S. T. Blake (Poaceae) from Vulnerable (Schedule 2) to Endangered (Schedule 1).

NSW Scientific Committee, 2002. Final Determination to list *Plinthanthesis rodwayi* (a grass) as an Endangered Species [WWW Document]. URL <http://www.environment.nsw.gov.au/determinations/PlinthanthesisRodwayiaGrassEndSpListin g.htm> (accessed 07.09.17).

NSW Scientific Committee (2009) Review of the Schedules of the Threatened Species Conservation Act 1995. A summary report on the review of selected species.

Ødum, S., 1975. "Seeds in ruderal soils, their longevity and contribution to the flora of disturbed ground in Denmark." *Proceedings of the 12th British Weed Control Conference, Brighton, 1974.*

NSW Office of Environment and Heritage (OEH) 2011. Geology 250k - Rock type spatial layer. Accessed 14/09/2017

Threatened Species Scientific Committee, 2008. Approved conservation advice for *Plinthanthesis rodwayi* (Budawang Wallaby Grass). Canberra: Department of the Environment.

Veldkamp, J.F., 1980. Conservation of *Notodanthonia Zotov* (Gramineae). *Taxon*, pp.293-298.

Expert Communications

Keith McDougall, Senior Threatened Species Officer, Office of Environment and Heritage, Queanbeyan NSW. Keith.McDougall@environment.nsw.gov.au