SAVING OUR SPECIES

Perisher wallaby grass (*Rytidosperma vickeryae*)

2023 survey, Kosciuszko National Park

Acknowledgement of Country

The Department of Planning and Environment acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

Report prepared by: Genevieve Wright[1], David Woods[2] and Mel Schroder[3]

[1] Department of Planning and Environment, Biodiversity and Conservation, South East Branch

[2] Starwood Agroforestry & Ecosystem Management

[3] Department of Planning and Environment, NSW NPWS

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Published by:
Environment and Heritage Group
Department of Planning and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and Heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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Executive summary

Perisher wallaby grass (*Rytidosperma vickeryae*) is a small threatened grass that occurs within Kosciuszko National Park and extends into adjacent private land to the east. It grows along streams and in montane peatland communities between 1,400 m and 1,800 m elevation. Perisher wallaby grass is currently a site-managed species in the NSW Government's Saving our Species (SoS) program, and conservation work on this species has been funded through this program.

The 2023 program surveyed 20 sites with Perisher wallaby grass present, 2 of these were new sites found during this work. In 2017, 18 of these sites were also surveyed; this report focuses mainly on the 2023 survey results.

The current survey has confirmed the persistence of Perisher wallaby grass at sites surveyed in 2017 and 2023, indicating this species is relatively stable over time. The sites surveyed were representative of the entire distribution of the species, falling within the northern extent in Happy Jacks Plain, central distribution in the Jagungal Wilderness and its southern distributional limit in the Perisher area. Assessment of current threats in 2023 indicate the species is reasonably secure and no direct impacts were observed to the species' habitat. However, impacts from feral species (pigs, deer, horses and rabbits) in Perisher wallaby grass habitat remain a potential threat. The maintenance of the current NSW National Parks and Wildlife Service (NPWS) feral species control program is critical for the long-term protection of this species.

Image 1 **Perisher wallaby grass habitat in Jagungal Wilderness Area, April 2019**
Image: G Wright/DPE

1. Background

Perisher wallaby grass (*Rytidosperma vickeryae*) is a small rhizomatous perennial grass up to 0.25 m high with small tufted leaves (Linder 1999). It occurs in the treeless plains in the high country of New South Wales, where it grows along stream edges or in montane peatland communities in close proximity to rivers and streams. Most populations occur within Kosciuszko National Park between 1,420 and 1,860 m elevation, but it is also found on adjoining private land to the east (Map 1).

Perisher wallaby grass is listed as endangered under the *Biodiversity Conservation Act 2016* and is currently a site-managed species in the SoS program. Site-managed species have a number of identified actions at specific sites to ensure their long-term conservation in the wild. Part of its distribution also occurs within NPWS Asset of Intergenerational Significance (AIS) areas and it is therefore afforded extra protection at these sites under the *National Parks and Wildlife Act 1974*.

One of the identified actions for this species is to survey for additional populations to increase the number of known sites. In 2017, funded by the SoS program, a survey was completed within 3 general localities in Kosciuszko National Park. Happy Jacks Plain (northern extent), the Jagungal Wilderness Area (Central area) and the Perisher area (southern extent) (Map 1) (OEH 2017). These areas contained all known records and extensive areas of potential habitat for the species.

The survey methods and site selection process utilised in this work are outlined in the 2017 report (OEH 2017). Locations for survey included: (i) old herbarium records, (ii) other known records with little survey data, and (iii) additional areas identified through visual assessment of vegetation patterns from the latest aerial imagery.

At each site surveyed, population extent and current or potential threats were recorded. Ecological observations were also made, and seed was collected if available. At new sites, herbarium specimens were collected and lodged in the state herbaria.

A total of 25 sites (8 in Happy Jacks, 14 in Jagungal and 3 in Perisher) were surveyed in Kosciuszko National Park in 2017. Thirteen of these were new sites found in the Jagungal and Happy Jacks Plain areas. This did not significantly increase the known extent of occurrence (EEO) of the Perisher wallaby grass but did increase the species' area of occupancy (AOO) (OEH 2017). Since the 2017 surveys, an additional 10 sites have been recorded within the species' known range. This further supports the proposition that this species is more widespread within its range than previously recorded.

It should be noted that the species' rhizomatous growth habit makes the identification of individual plants in the field very difficult. So, although the 2017 and subsequent incidental surveys found additional populations whose areas of occupancy were delineated, the number of plants in each population remains unknown.

In 2017, long-term monitoring plots (0.25 m square) were also established at 2 localities, Perisher and Betts Creek (20 plots, 10 at each locality). The total inflorescences for each plot were counted annually during the peak flowering period for 5 years. These plots were established to provide data on annual changes in flowering and possible impacts of co-occurring exotic perennial grasses.

2. Purpose

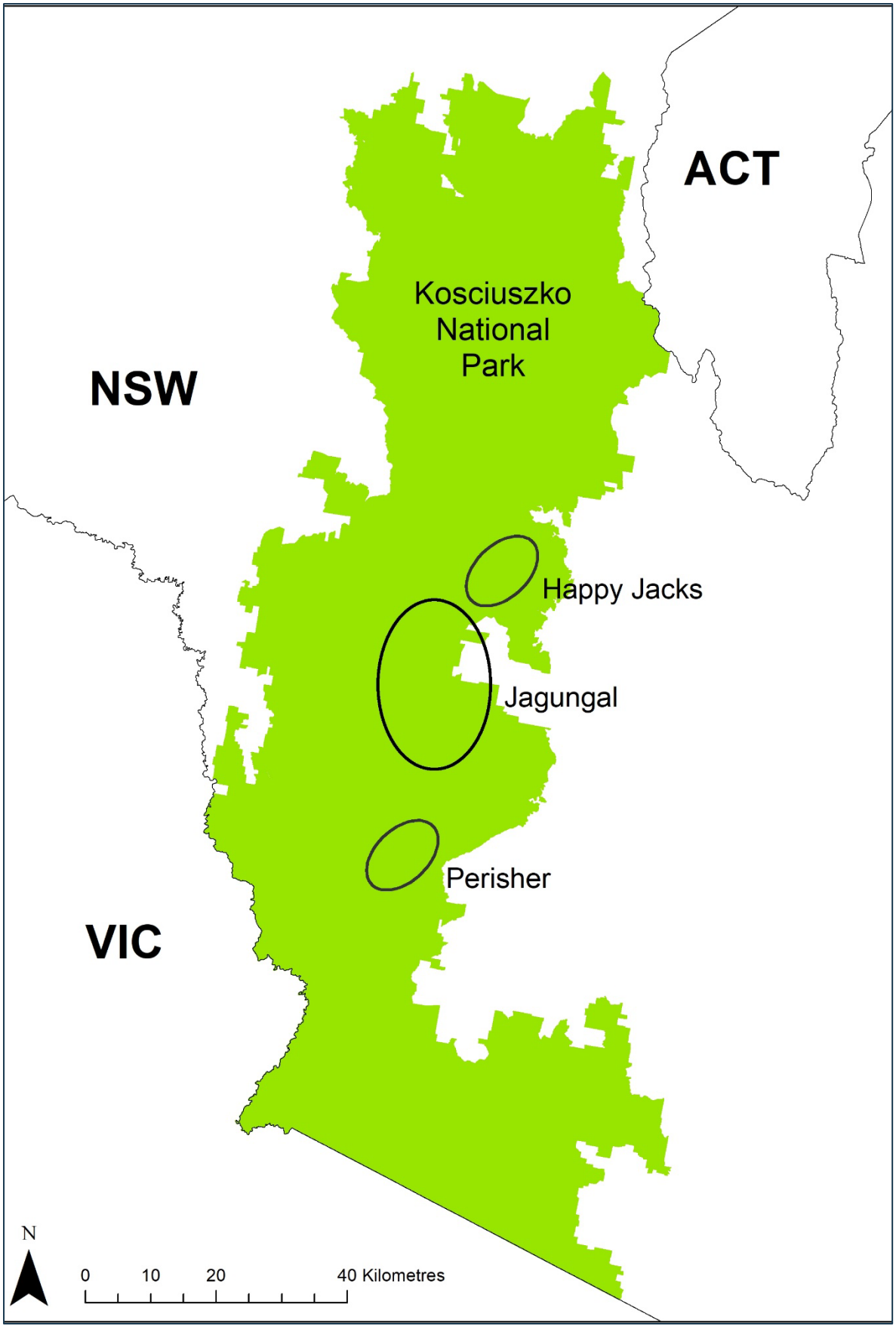
The main purpose of this project was to repeat the 2017 Perisher wallaby grass survey to determine whether populations of this species are persistent and occupy the same or similar areas over time (OEH 2017). Additional objectives of the project included: identifying any current or potential threats; identifying and surveying new locations in potential habitat; and recording ecological observations at sites surveyed.

The 2023 survey was conducted in Happy Jacks Plain, Jagungal Wilderness Area and the Perisher/Betts Creek areas of Kosciuszko National Park. The following report provides comment on ecological observations made, potential and/or emerging threats, and makes recommendations for the future conservation management of the species.

The report also includes information on new locations for the species found since the 2017 surveys.

Image 2 **Perisher wallaby grass remote survey team in Jagungal Wilderness Area, March 2023**

Image: G Wright/DPE



Map 1 **Perisher wallaby grass extent in Kosciuszko National Park**

3. Survey and results

Field surveys in 2023 included all 2017 sites with extant populations, and 11 previously unsurveyed sites identified in suitable habitat (6 Happy Jacks, 4 Jagungal, 1 Perisher). These additional sites were identified through visual assessment of vegetation patterns from the latest aerial imagery (source: NSW Land and Property Information [NSW LPI]). The total number of sites surveyed in Kosciuszko National Park in 2023 was 27 (10 Happy Jacks, 14 Jagungal, 3 Perisher).

3.1 Perisher area

Surveys in the Perisher area (Perisher Creek, Betts Creek and Spencers Creek) were completed on 7 March 2023. The sites included Perisher Creek, east of the Perisher car park, Betts Creek, Spencers Creek above the bridge on Kosciuszko Road, and one new site in the upper reaches of Spencers Creek below Charlotte Pass village.

3.2 Happy Jacks and Jagungal

In Happy Jacks Plain and the Jagungal Wilderness Area, due to the remote location of sites, helicopter assisted surveys were conducted (Image 2). These were completed on 8, 9 and 24 March 2023. In Happy Jacks Plain all 4 2017 sites were resurveyed and an additional 6 new sites surveyed. In Jagungal, all 10 2017 sites were resurveyed and 4 new sites surveyed.

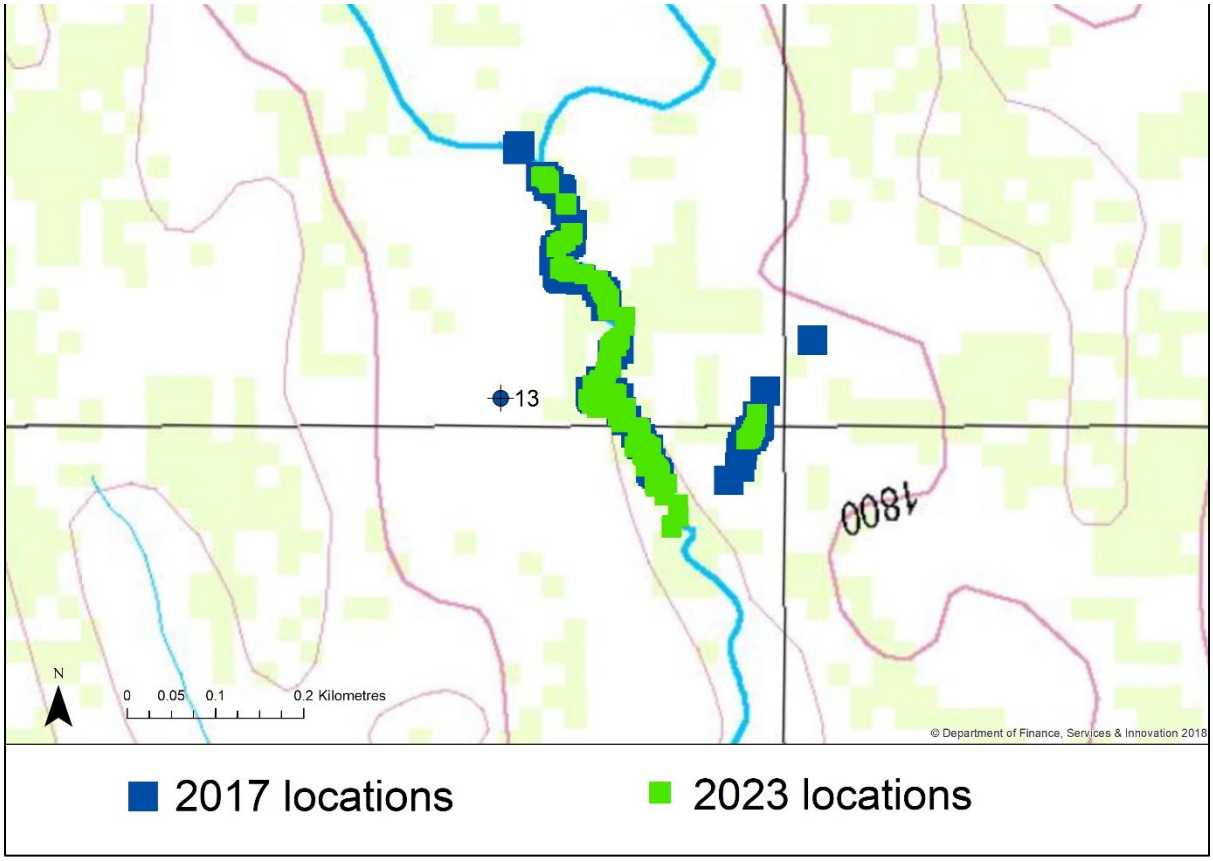
3.3 Survey method

The extent of an individual Perisher wallaby grass plant cannot be readily identified in the field. The species has a rhizomatous habit with tufts of leaves growing at intervals along a rhizome (NSW Flora online 2023); leaf length is up to 6 cm (Linder 1999), but flowering stems are between 10 and 15 cm tall.

The survey method developed for this species was based on the presence of flowering stems, or inflorescences. It is at this stage that Perisher wallaby grass can be readily distinguished from other species with which it grows, in the leaf stage it is indistinguishable from co-occurring grasses.

The survey method was as follows: If there were contiguous patches of flowering plants (such as along the creek edge) GPS points were recorded every 2 m. Discrete patches (<3 m) were logged as a single GPS point. A patch was defined as plants present within 2 m of the previous sample point (Map 2).

This same method was used in both the 2017 and 2023 surveys.



Map 2 **Perisher wallaby grass locations at site 13, survey methodology used in 2017 and 2023**

3.4 Happy Jacks Plain

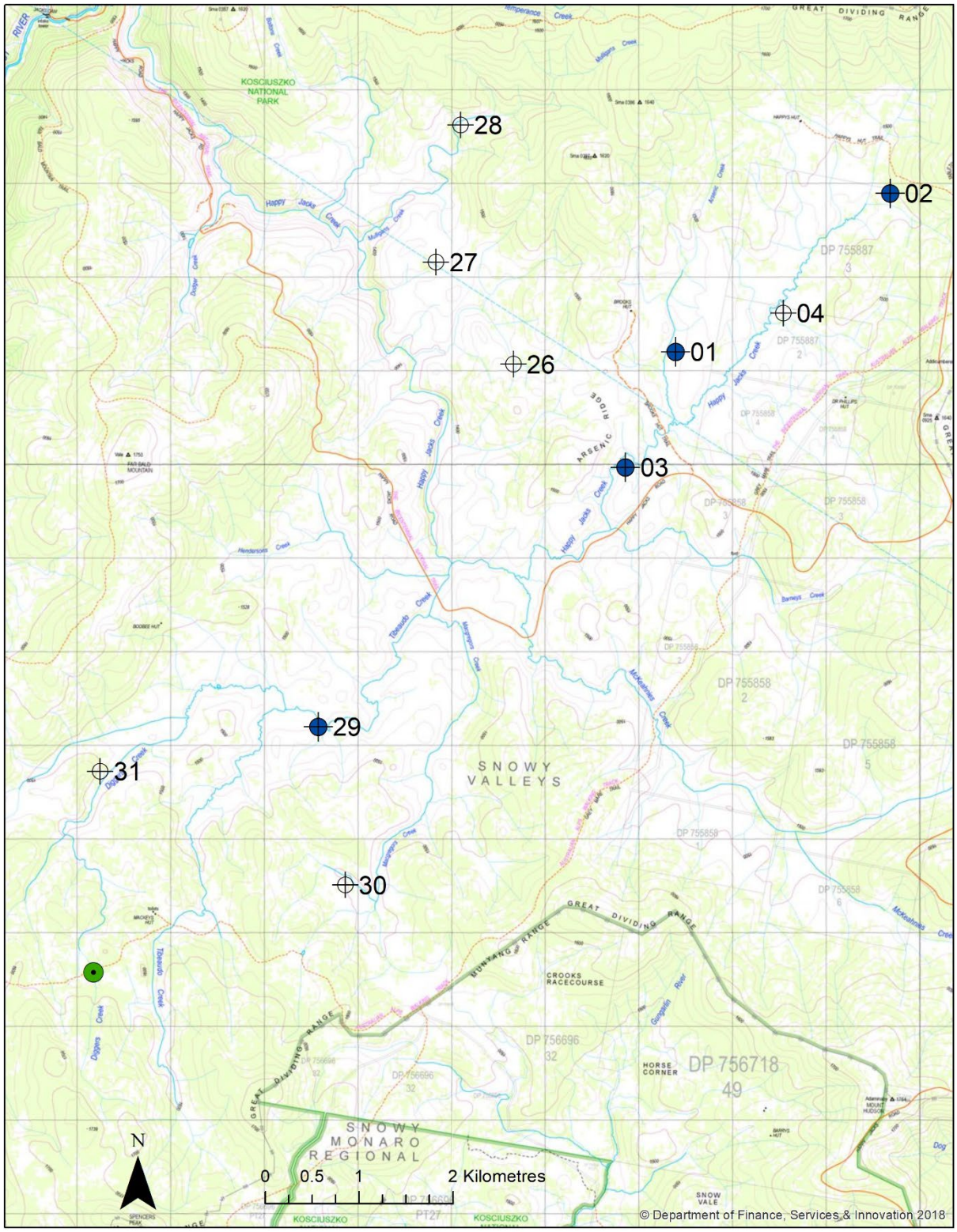
Happy Jacks Plain is one of the largest treeless plains in the Kosciuszko National Park and is the northern most known distribution of Perisher wallaby grass.

In 2017 6 sites in this area were surveyed for Perisher wallaby grass; plants were found at 4 of these sites (sites 1–4, Map 3) (OEH 2017). In 2019–20 a high severity wildfire burnt through Happy Jacks Plain impacting all 4 known sites, and in February 2021 these were resurveyed to see if any plants remained (DPE 2022). Plants were only located at 2 of the 4 sites (1 and 3). At that time, the post-fire regrowth was tall and dense and vegetation in the plain did not resemble the observed pre-fire patterns. It was concluded that another survey should be conducted as the tall regrowth could have obscured recovering plants, and if so, plants not in flower would not be detected (DPE 2022). These same 4 sites were resurveyed in March 2023 and plants were found at 3 of the locations (sites 1, 2 and 3, Map 3).

The 2023 survey included an additional 6 sites in potential habitat that had not been surveyed before (sites 26–31, Map 3). Only one of these sites (29) was a newly located population (Map 3).

There is one incidental record in Happy Jacks Plain, located in 2019 at a crossing on the Grey Mare fire trail. The total number of known sites in this area is currently 5.

Image 3 **Happy Jacks Plain, post-2020 wildfire, February 2022**
Image: G Wright/DPE



Map 3 **Survey sites, Happy Jacks Plain, Kosciuszko National Park, 2023**

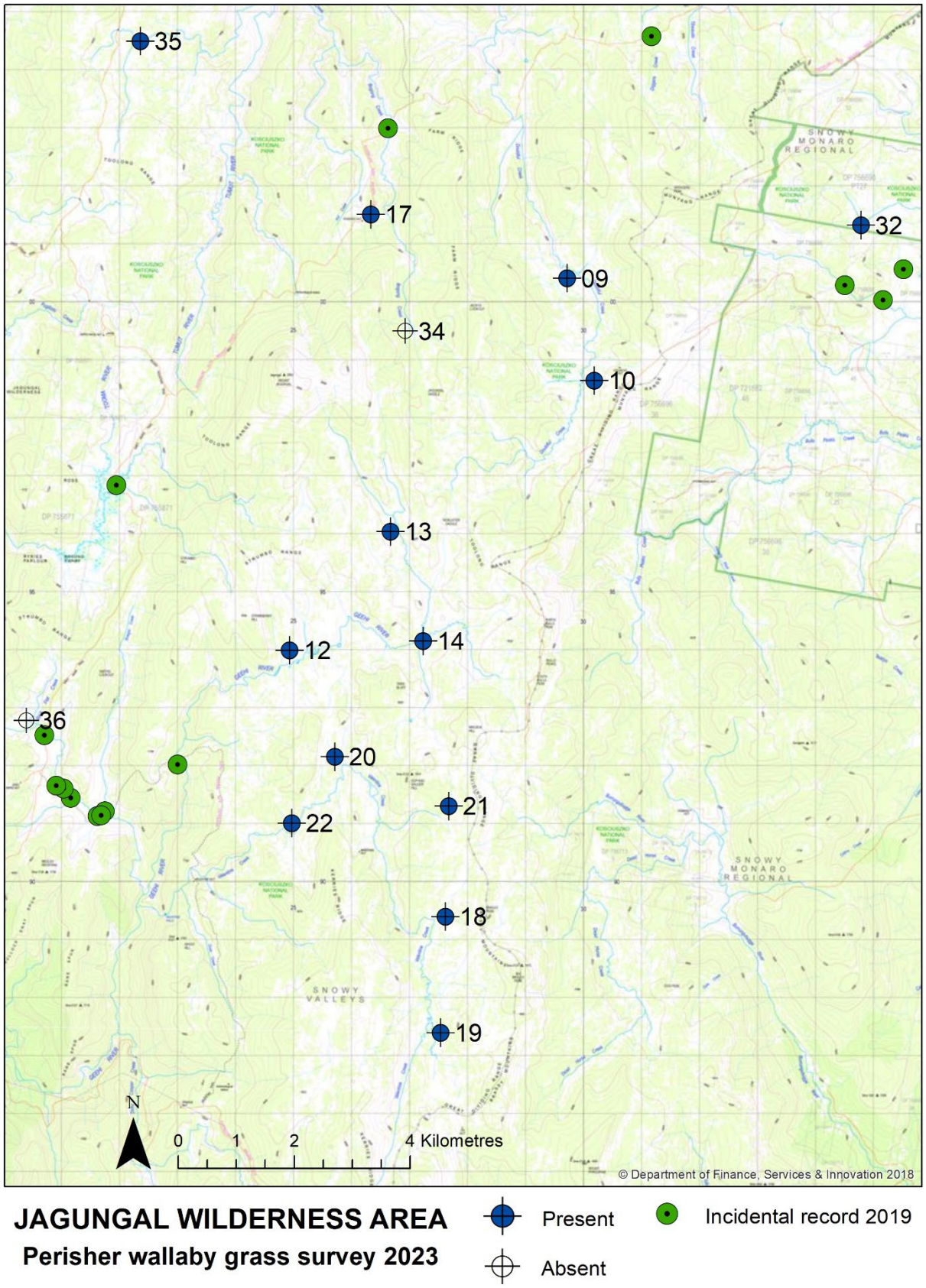
3.5 Jagungal Wilderness Area

The Jagungal Wilderness Area, in the central part of Kosciuszko National Park, includes most of the high plateau country in the park (67,432 ha), outside of the alpine area.

In 2017, 11 of the sites surveyed had extant populations of Perisher wallaby grass. All these sites were resurveyed in 2023 and an additional 4 sites were surveyed for the first time (32, 34, 35, 36) (Map 4). Two of the new sites surveyed had populations of Perisher wallaby grass, and all of the 11 sites resurveyed still had populations present.

An additional 9 incidental locations were found in 2019, so the current total known sites for the Jagungal Wilderness Area is 22.

Image 4 **Site 22 in Jagungal Wilderness Area, March 2023**
Image: G Wright/DPE



Map 4 **Survey sites, Jagungal Wilderness Area, Kosciuszko National Park, 2023**

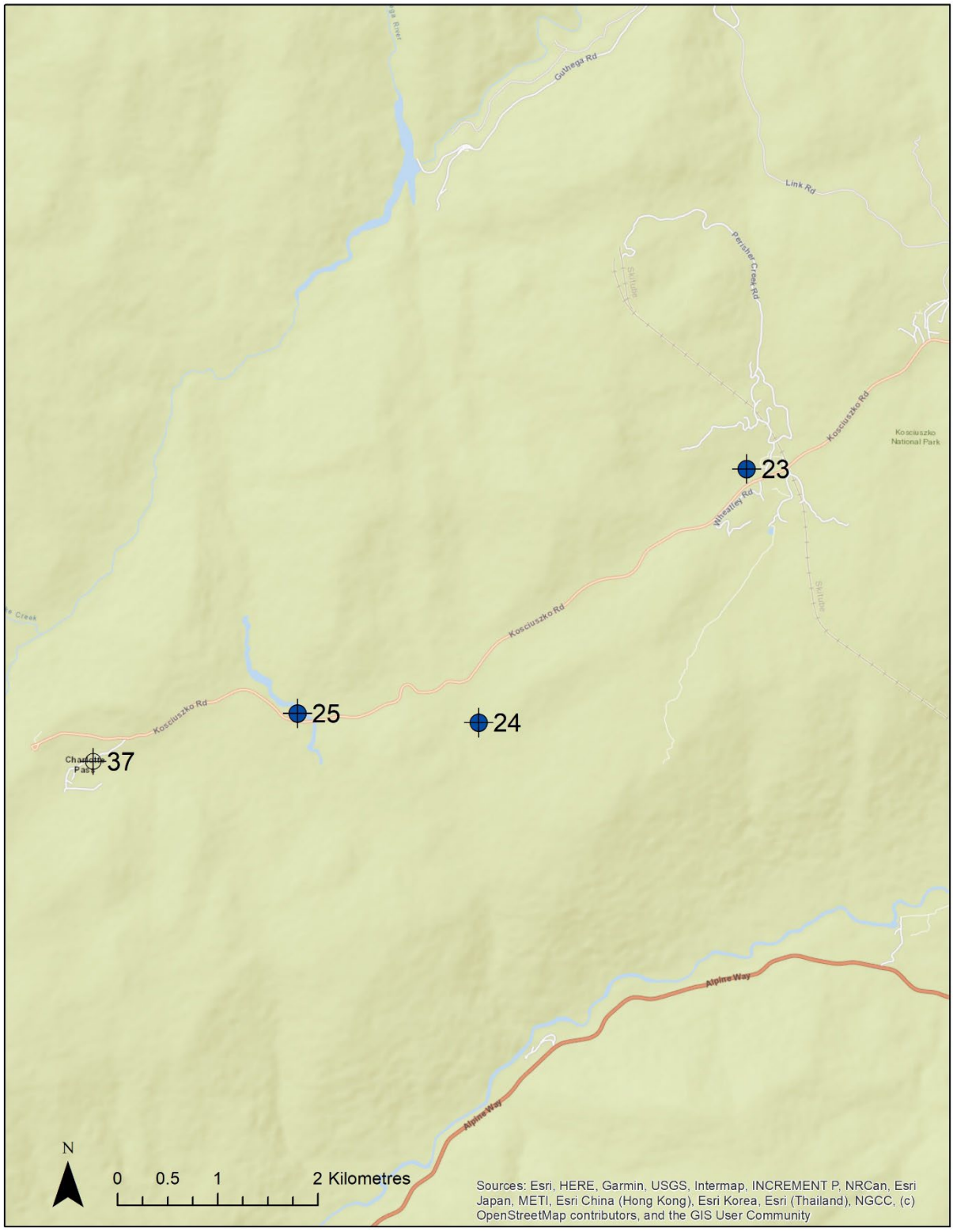
3.6 Perisher

The Perisher area populations of Perisher wallaby grass occur within 2 general localities: along Perisher Creek (falling within the Perisher ski resort area); and in the Spencers Creek catchment, with plants growing along Guthrie and Betts creeks, which both flow into Spencers Creek (Map 5).

In 2017 surveys were completed at 2 localities in Perisher, one in the Perisher Creek area and the other along Betts Creek (sites 23 and 24, Map 5). In 2023, these 2 areas were resurveyed with 2 additional sites also surveyed: one upstream of the bridge on Kosciuszko Road (site 25, Map 5), the other in upper Spencers Creek below Charlotte Pass ski village (site 37, Map 5). Site 25 was known to have a population of Perisher wallaby grass but had not been surveyed previously; site 37 was previously unsurveyed. These surveys confirmed extant populations in all sites visited, except for upper Spencers Creek (site 37), where no plants were found.

No new locations were found in the Perisher area; there are a total of 3 known sites.

Image 5 **Perisher wallaby grass habitat in Perisher area, Betts Creek, March 2023**
Image: G Wright/DPE



Map 5 **Survey sites, Perisher area, Kosciuszko National Park, 2023**

3.7 Perisher monitoring plots

In 2017, permanent monitoring plots were established at 2 localities in the Perisher area, along Perisher Creek and Betts Creek. The 20 plots (10 at each locality) were 0.25 m square, and each plot was permanently marked using 2 metal pins in diagonal corners of the quadrat. Inflorescences within each plot were counted annually, during the peak flowering period (February–March). The number of exotic perennial inflorescences were also recorded if present. Data were collected for 6 consecutive years, from 2017 to 2022.

The ability to detect this species during survey relies on the presence of flowering stems, as the leaves are inconspicuous and not readily distinguishable from other co-occurring grasses. An understanding of the variability of Perisher wallaby grass flowering between years, specifically the number of inflorescences produced, provides valuable information on the ability to readily track population persistence over time. At these sites we have also compared the number of flowering heads with climate data to understand any possible correlations.

The invasion of native plant communities by exotic perennial grasses is listed on Schedule 4 of the *Biodiversity Conservation Act 2016*, as a key threatening process (DPE 2023b). This is an emerging threat in the habitat where Perisher wallaby grass occurs. The Perisher sites, in particular, are close to disturbance associated with ski resort infrastructure and have the exotic perennial grasses browntop bent (*Agrostis capillaris*) and red fescue (*Festuca rubra*) co-occurring at 3 sites. Monitoring of these species may detect changes in their occurrence and possible corresponding changes in *Rytidosperma vickeryae* cover.

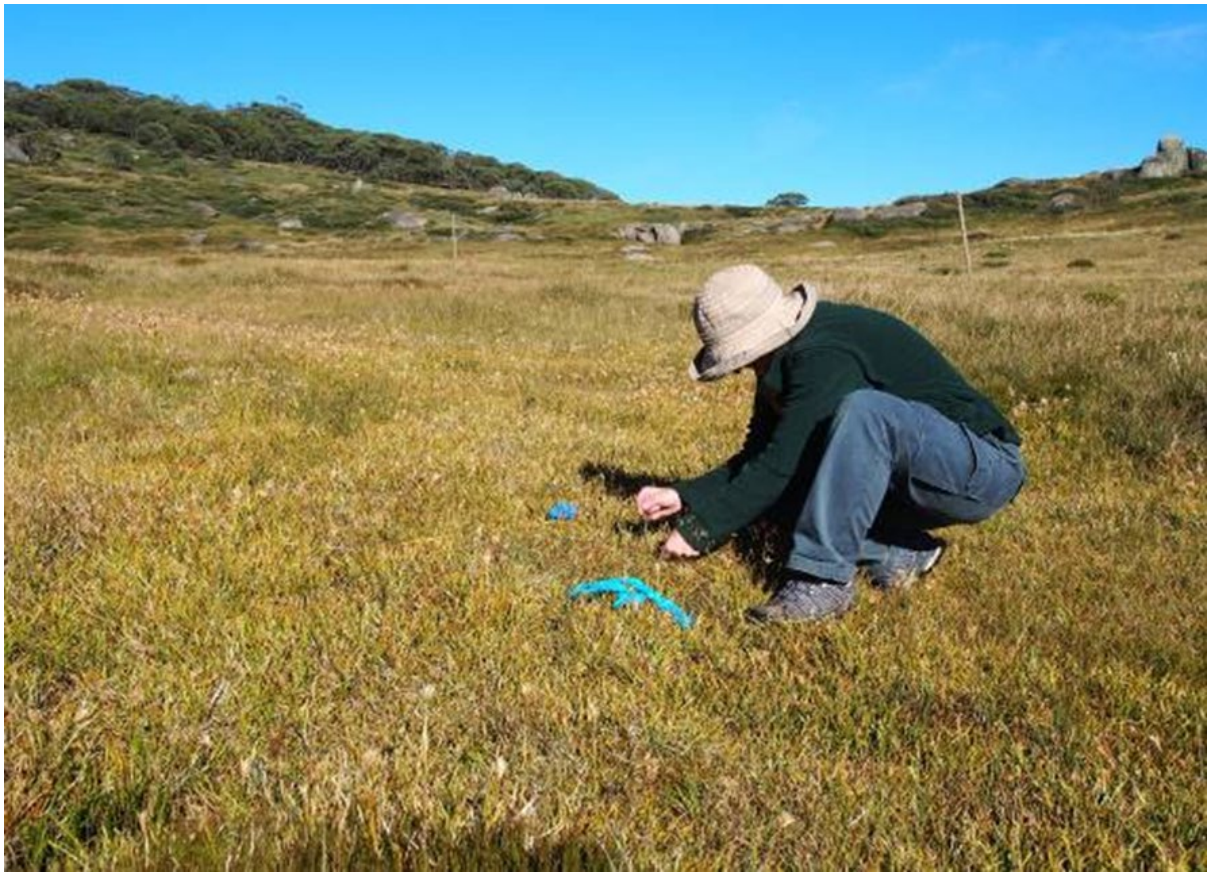


Image 6 **Betts Creek monitoring plot, March 2017**
Image: G Wright/DPE

4. Results

4.1 Survey results

In 2023 a total of 29 sites were surveyed for Perisher wallaby grass (10 in Happy Jacks, 15 in Jagungal and 4 in Perisher); at 9 of these sites (4, 26–28, 30, 31, 34, 36, 37) no plants were found. The other 20 sites had Perisher wallaby grass present. Three of these were new sites found in the 2023 survey (29, 32 and 35 – Table 1, Maps 3 and 4).

In 2017, 18 sites had extant populations of Perisher wallaby grass. The 2023 survey found 17 of these sites still had populations of the species. The only site where plants could not be found (Site 4, Happy Jacks Plain) was within the 2019–20 wildfire boundary (Table 1).

Table 1 Perisher wallaby grass 2017 and 2023 surveys

Site name	Site number	2017 (count)	2023 (count)	Comment
Happy Jacks	1	1	1	
	2	1	1	
	3	10	2	
	4	4	0	
	29	n/a	9	New site 2023
Jagungal	9	14	7	
	10	72	70	
	12	17	14	
	13	76	126	
	14	35	62	
	17	4	2	
	18	3 x 3 m area	87	No 2017 count
	19	79	92	
	20	37	52	
	21	19	25	
	22	30	24	
	32	3 x 4 m area	2	New site 2023
	35	6 x 6 m area	3	New site 2023
Perisher	23a		35	
	23b		33	
	24		462	
	25		59	No 2017 survey

Direct comparison of results is only possible for 14 of the 17 sites surveyed in both 2017 and 2023. The sites where direct comparisons can be made are those that had the same

sections of stream bank habitat surveyed (Table 1). These all indicate that Perisher wallaby grass is persistent in the same area over time, although the spatial distribution of flowering differed between years.

4.2 Monitoring plots

Monitoring at 2 locations in the Perisher area indicates plants have persisted at both sites over a 5-year period (between 2017 and 2021). The average number of flowering stems recorded in the plots fluctuated between years at the 2 monitoring locations (Figure 1), with the number of flower stems in plots at Betts Creek showing a declining trend over time.

Three plots at Perisher Creek were not monitored consistently due to the removal of site markers.

Two species of exotic grass occur at 3 of the Perisher Creek plots. *Agrostis capillaris* and *Festuca rubra* were consistently detected but showed no significant change in the number of flowering stems recorded annually. No exotic grasses were recorded at Betts Creek. The perennial exotic grass *Anthoxanthum odoratum*, while not detected in the survey plots, has expanded its distribution in the Perisher Creek area.

Climate data, collected from the Perisher Valley Bureau of Meteorology site, was examined to determine if average summer temperature and rainfall could explain differences in annual flowering. It was not significant but with a longer-term dataset could be re-examined.

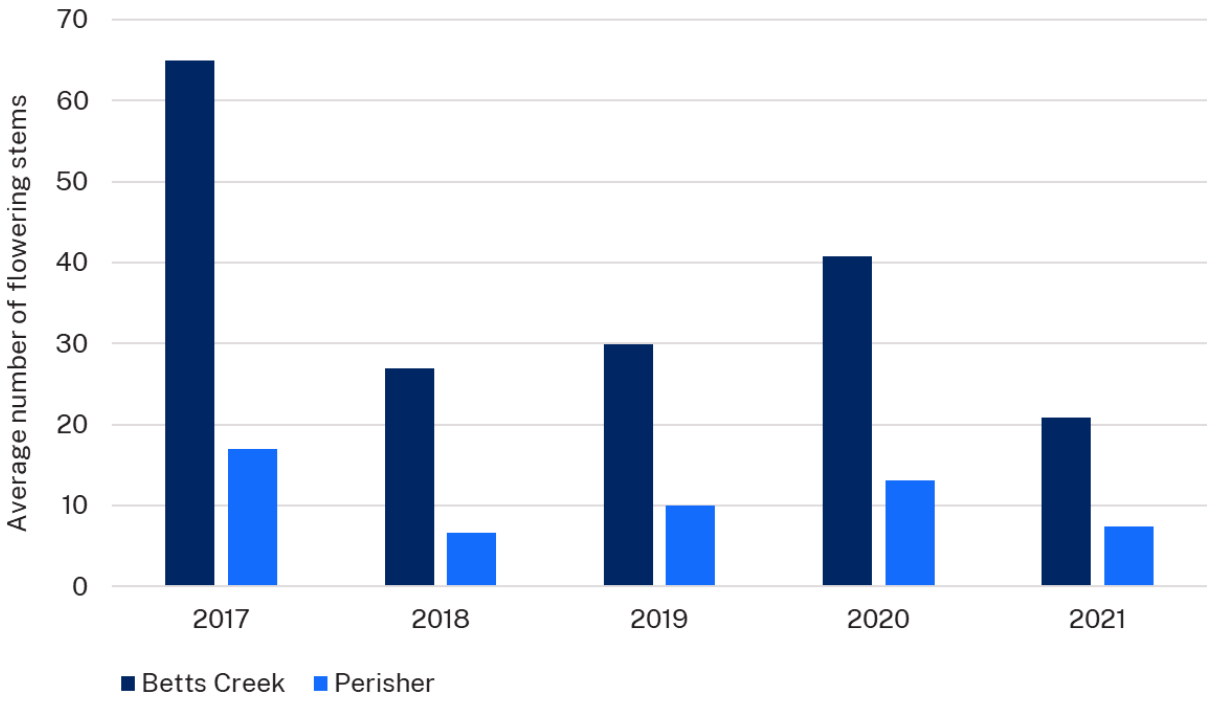


Figure 1 Results of surveys of Perisher wallaby grass plots, 2017–2021

4.3 Ecological observations

During the current survey the habitat preference of Perisher wallaby grass within its range was observed and recorded. The species occurs, and appears restricted to, the following habitats in the treeless vegetation: stream edges dominated by *Sphagnum* (Image 7), stream edges dominated by *Carex* (Image 8), and the edges of pools that occur adjacent to streams and rivers (Image 9). The final habitat type, seen less frequently, is flat, low-lying sites adjacent to areas of subalpine shrub bog (Image 10).

Image 7 **Perisher wallaby grass habitat at Spencers Creek, vegetation dominated by *Sphagnum*, March 2023**
Image: G Wright/DPE

Image 8 **Jagungal Wilderness Area, Valentine Creek, lower tiers next to creek dominated by *Carex*, March 2023.** Image: G Wright/DPE

Image 9 **Jagungal Wilderness Area, habitat on edge of pools adjacent to Doubtful Creek, March 2017.** Image: M Schroder/DPE

Image 10 **Kosciuszko National Park, Patrick's Paddock, a site within the 2019–20 burn area, growing above a small patch of recovering subalpine shrub bog, March 2023.** Image: G Wright/DPE

4.4 Threats

There were no direct threat impacts observed to Perisher wallaby grass habitat during the 2023 surveys; however, observations were made of pig rooting, feral horse grazing and dung and deer scats in the treeless vegetation surveyed. All 3 of these feral species have potential to impact Perisher wallaby grass habitat and plants, particularly if numbers are not kept at low levels through effective control programs.

5. Discussion

Perisher wallaby grass (*Rytidosperma vickeryae*) is a small rhizomatous perennial grass up to 0.25 m high with small tufted leaves (Linder 1999). It is distributed in the treeless plains of the high country of New South Wales and grows along stream edges or on the margins of montane peatland communities. Most populations occur within Kosciuszko National Park between 1,420 and 1,860 m elevation, but it is also found on adjoining private land to the east of the park, on the edge of Snowy Plain (Map 1).

Perisher wallaby grass is listed as endangered under the *Biodiversity Conservation Act 2016* (OEH 2011) and is currently a site-managed species in the SoS program. Part of its distribution also occurs within NPWS AIS areas, and it is therefore afforded extra protection at these sites (DPE 2023a).

This 2023 survey of Perisher wallaby grass was done as a follow-up action to the 2017 survey funded by the SoS program, which confirmed old species records and significantly increased the area in which the species was known to occur (OEH 2017). Although the distribution of the species was better understood after the 2017 work, the persistence of populations over-time had not been investigated. The long-term stability of a species is a critical consideration in the development of a conservation strategy for any threatened species. The results of this 2023 survey were compared to those from 2017 to provide a better understanding of management needs for the species in the future.

In March 2023, all the 2017 Perisher wallaby grass sites were resurveyed. The same survey methodology was utilised, and results confirmed that 16 of the 17 sites that had populations in March 2017, were present 6 years later in 2023. One site in Happy Jacks Plain could not be relocated. All sites in this area were burnt in a high intensity fire in 2019–20 so the loss of this site is most likely attributable to wildfire impacts.

The data from the monitoring plots established in 2017 at Betts and Perisher supports the survey results of population persistence over time. Perisher wallaby grass persisted over a 5-year period within all plots monitored. The data on the number of flowering stems produced by Perisher wallaby grass showed that this is variable between years.

Ecological observations of habitat preference during the 2023 surveys confirmed the species is confined to treeless plain vegetation. Perisher wallaby grass occurred along stream edges dominated by *Sphagnum* and *Carex* (Image 11) and on the edges of pools adjacent to streams and rivers; less frequently it was observed on flat low-lying sites adjacent to areas of subalpine shrub bog. These were at lower elevation sites (<1,500 m).

There were no direct threat impacts observed to Perisher wallaby grass habitat during the 2023 surveys; however, observations were made of pig rooting, feral horse grazing and dung and deer scats in the surrounding treeless vegetation. All 3 of these feral species have potential to impact Perisher wallaby grass habitat and plants, particularly if numbers are not kept at low levels through effective control programs. Subsequent observations in Snowy Plains showed direct impact to potential habitat from pig rooting activity.

Populations of the species in the Perisher Creek area occur near ski resort development and activity. Riparian vegetation and wetlands were impacted during construction of the resort, which required the diversion of streams, introduction of exotic species for soil stabilisation and increased stormwater runoff. It is likely that this has caused a decline in suitable habitat for this species in the Perisher Valley and ongoing development has potential to impact current populations.

The monitoring plots established in the Perisher area included 2 species of exotic grasses, browntop bent (*Agrostis capillaris*) and red fescue (*Festuca rubra*); no exotic grasses were recorded at Betts Creek. The results indicated the cover of these exotic species did not significantly increase over time; however, the invasion of native plant communities by exotic

perennial grasses is listed as a key threatening process on the *Biodiversity Conservation Act 2016* and there are a number of perennial grasses that have increased in cover in the alps over the last 30 years. Sweet vernal grass (*Anthoxanthum odoratum*), whilst not detected in the survey plots, has expanded its distribution throughout Kosciuszko National Park, including in the Perisher Creek and Betts Creek areas, and has potential to invade Perisher wallaby grass habitat in the future. This invasive species has had the largest increase in occurrence along roads in Kosciuszko National Park between 2007 and 2017 (McDougall et al., 2017).

Image 11 **Perisher wallaby grass growing in *Sphagnum* on stream edge, March 2023**
Image: G Wright/DPE

The current survey has confirmed the persistence of Perisher wallaby grass at sites surveyed in 2017 and 2023, indicating this species is relatively stable over time. The sites surveyed were representative of the entire distribution of the species, falling within the northern extent in Happy Jacks Plain, central distribution in the Jagungal Wilderness and its southern distributional limit in the Perisher area. Assessment of current threats in 2023 indicate the species is reasonably secure and no direct impacts were observed to the species' habitat. However, impacts from feral species (pigs, deer, horses and rabbits) in Perisher wallaby grass habitat remain a potential threat. The maintenance of the current NPWS feral species control program is critical for the long-term protection of this species.

6. Recommendations

It is recommended that, based on the survey results, this species be reassigned from the site-managed stream to the keep watch management stream of the SoS program. Between 2017 and 2023, 30 known sites of Perisher Wallaby grass have been confirmed and the persistence of 17 of these between 2017 and 2023 established.

If reassigned to keep watch, monitoring of the 20 permanent plots at Perisher and Betts Creek should be completed every 3 years. Long-term population monitoring should also be undertaken every 5 years as part of SoS threatened species project implementation.

Ongoing provision of information to key NPWS and ski resort personnel to assist the identification of this species is recommended. This should be maintained to prevent impact from any future infrastructure works in the Perisher Valley.

NPWS weed and feral animal control programs should be maintained to protect Perisher wallaby grass habitat from adverse impacts.

7. References

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Appendix A – Perisher wallaby grass sites

Happy Jacks Plain – Site 1, Arsenic Creek (2017 site)

Location (GDA94): Easting: 637290; Northing: 6011294

Date: 9 March 2023

Elevation: 1,460 m

Slope: 5 degrees

Notes: Growing on the western bank of Arsenic Creek adjacent to a *Sphagnum* bog complex. This site was burnt in the 2019–20 wildfire. Surveys in February 2022 and March 2023 relocated the same small, local patch of plants first found in the 2017 surveys. The bog complex has still not recovered with no live *Richea continentis* evident, but small patches of *Sphagnum cristatum*. Associated species are *Carex gaudichaudiana*, *Empodisma minus*, *Epacris celata*, *Cotula alpina*, *Juncus falcatus* and *Cassinia monticola*.

Survey count: 1 in 2017, 1 in 2022, 1 in 2023

Happy Jacks Plain – Site 2, Happy Jacks Creek (2017 site)

Location: (GDA94): Easting: 639470; Northing: 6012851

Date: 9 March 2023

Elevation: 1,480 m

Slope: 5 degrees

Notes: Growing on the eastern bank of the upper reaches of Happy Jacks Creek, approximately 1.1 km south-east of Happys Hut. This site was burnt in the 2019–20 wildfire. Surveys in February 2022 and March 2023 of the 2017 location did not locate any plants; in March 2023 although no plants were found at the original 2017 location, a small patch of plants (1 m x 1 m) was found 55 m downstream of this original site. Associated species are *Epacris celata*, *Cassinia monticola*, *Carex gaudichaudiana* and *Empodisma minus*.

Survey count: 1 in 2017, 0 in 2022, 1 in 2023

Happy Jacks Plain – Site 3, Happy Jacks Creek (2017 site)

Location: (GDA94): Easting: 636935; Northing: 6010083

Date: 9 March 2023

Elevation: 1,440 m

Slope: 5 degrees

Notes: Growing on the eastern and western bank of Happy Jacks Creek, approximately 1.5 km south of Brooks Hut and up and downstream from old Snowy Hydro infrastructure. This site was burnt in the 2019–20 wildfire. Surveys of this site in both February 2022 and March 2023 located flowering plants; although in all survey years, flowering plants were found in different locations along the same section of stream. The highest count was in 2017, pre-fire, but the persistence post-fire, although in lower numbers indicates this species has some resilience to fire. Associated species *Carex gaudichaudiana*, *Hypericum japonicum*, *Gonocarpus micranthus*, *Viola fuscoviolacea*, *Hydrocotyle algida*, *Ranunculus pimpinellifolius*, *Agrostis* sp., *Baloskion australe*.

Survey count: 10 in 2017, 4 in 2022, 2 in 2023

Happy Jacks Plain – Site 4, Happy Jacks Creek (2017 site)

Location (GDA94): Easting: 638393; Northing: 6011645

Date: 9 March 2023

Elevation: 1,460 m

Slope: 5 degrees

Notes: Growing on the banks of Happy Jacks Creek, approximately 1.5 km east of Brooks Hut. This site was burnt in the 2019–20 wildfire. Surveys of this site in both February 2022 and March 2023 located no flowering plants. The post-fire vegetation was tall and dense and it is possible that surveys in the future may relocate plants in this section of Happy Jacks Creek. Associated species *Carex gaudichaudiana*, *Hypericum japonicum*, **Trifolium repens*, *Epilobium billardierianum*, *Gonocarpus micranthus*, *Carex* sp., *Agrostis* sp., *Oreomyrrhis ciliata* and *Ranunculus pimpinellifolius*.

Survey count: 4 in 2017, 0 in 2022, 0 in 2023

*exotic species

Happy Jacks Plain – Site 29, Diggers Creek (new site)

Location (GDA94): Easting: 633577; Northing: 6007193

Date: 9 March 2023

Elevation: 1,440 m

Slope: 5 degrees

Notes: Growing on the banks of Tibeaudo Creek, approximately 2 km south-east of Boobee Hut. This site was burnt in the 2019–20 wildfire. Both banks of a 250 m section of the creek were surveyed. Perisher wallaby grass at this site is growing where *Carex gaudichaudiana* is less dense along the creek edge.

Associated species *Coronidium scorpioides*, *Cassinia monticola*, *Veronica derwentiana*, *Ozothamnus cupressoides*, *Empodisma minus*, *Poa sieberiana*, *Poa costiniana*, *Poa clivicola*, *Grevillea australis*, *Epilobium billardierianum* subsp. *hydrophilum* and *Leptorhynchos squamatus*.

Survey count: 9 in 2023

Jagungal – Site 9, Doubtful Creek 1 (2017 site)

Location (GDA94): Easting: 629750; Northing: 6000552

Date: 10 March 2023

Elevation: 1,610 m

Slope: 5 degrees

Notes: Doubtful Creek headwaters, approx. 1.9 km NNW of Cesjacks Hut. Site unburnt in 2019–20 wildfires. Fewer flowering plant found in 2023 surveys, but the same section of stream was surveyed. Associated species *Sphagnum cristatum*, *Empodisma minus*, *Erigeron nitidulus*, *Epacris glacialis*, *Aciphylla simplicifolia* and *Carex gaudichaudiana*.

Survey count: 14 in 2017, 7 in 2023

Jagungal – Site 10, Doubtful Creek 2 (2017 site)

Location (GDA94): Easting: 629929; Northing: 5998583

Date: 10 March 2023

Elevation: 1,660 m

Slope: 5 degrees

Notes: Doubtful Creek approx. 750 m south-west of Cesjacks Hut. Site unburnt in 2019–20 wildfires. Growing in lower tiers adjacent to creek, fen margins sedgeland/grassland interface with *Sphagnum*. The same number of points with flowering plants were recorded in the 2023 and 2017 surveys, the same section of stream was surveyed. Associated species *Poa costiniana*, *Empodisma minus*, *Gentianella muelleriana* ssp. *alpestris*, *Hydrocotyle* sp., *Oreomyrrhis ciliata* and *Sphagnum cristatum*.

Survey count: 72 in 2017, 70 in 2023

Jagungal – Site 12, Geehi River 1 (2017 site)

Location (GDA94): Easting: 624824; Northing: 5993830

Date: 3 February 2017

Elevation: 1750 m

Slope: 5 degrees

Notes: Tributary to Geehi River, approx. 980 m south-east of Strawberry Hill and 400 m section of Geehi River Jagungal Wilderness Area. Growing along edge of stream and near margin of alpine bog and grassland. Associated species *Sphagnum cristatum*, *Empodisma minus*, *Poa costiniana*, *Erigeron nitidulus* and *Carex gaudichaudiana*. *Richea continentis*, *Carpha nivicola*, *Carex gaudichaudiana* and *Poa costiniana.*

Survey count: 17 in 2017, 14 in 2023

Jagungal – Site 13, Geehi River 2 (2017 site)

Location (GDA94): Easting: 626804; Northing: 5996071

Date: 10 March 2023

Elevation: 1,790 m

Slope: 5 degrees

Notes: Upper Geehi River, approx. 3.2 km south-east of Mt Jagungal trig. Growing on riverbank, easterly aspect. Moist grassland/sedgeland interface. Associated species *Carex gaudichaudiana*, *Poa costiniana*, *Empodisma minus*, *Epacris celata* and *Juncus falcatus*.

Survey count: 76 in 2017, 126 in 2023

Jagungal – Site 14, Geehi River 3 (2017 site)

Note: There is no image for this site.

Location (GDA94): Easting: 626796; Northing: 5996146

Date: 10 March 2023

Elevation: 1,770 m

Slope: 5 degrees

Notes: Tributary to Geehi River, approx. 2 km west of North Bulls Peak and 300 m section of Geehi River. Growing out of *Sphagnum cristatum* occurring along the edge of a long pool and along riverbanks. High subalpine treeless plain. Associated species *Sphagnum cristatum*, *Empodisma minus*, *Carex gaudichaudiana*, *Poa costiniana* and *Oreomyrrhis ciliata*.

Survey count: 35 in 2017, 62 in 2023

Jagungal – Site 17, O'Keefes Hut (2017 site)

Location (GDA94): Easting: 626230; Northing: 60001478

Date: 10 March 2017

Elevation: 1,610 m

Slope: 5 degrees

Notes: Upper reaches of Hut Creek, 90 m north of O'Keefes Hut. Growing along a small creekline near its junction with Grey Mare fire trail. Fen-like vegetation. Associated species *Empodisma minus*, *Epilobium sarmentaceum*, *Carex gaudichaudiana*, *Juncus falcatus*, *Poa costiniana*, *Gonocarpus micranthus* and *Oreomyrrhis ciliata*.

Survey count: 4 in 2017, 2 in 2023

Jagungal – Site 18, Valentine Creek 1 (2017 site)

Location (GDA94): Easting: 626229; Northing: 6001476

Date: 24 March 2023

Elevation: 1,830 m

Slope: 5 degrees

Notes: 250 m of tributary flowing into Valentine Creek and 450 m of Valentine Creek. Approx. 720 m west of Brassy Peak, Jagungal Wilderness Area. Growing next to a small flowing creek. Associated species *Empodisma minus*, *Carex gaudichaudiana* and *Erigeron nitidulus*.

Survey count: 3 m x 3 m area, no count in 2017, 87 in 2023

Jagungal – Site 19, Valentine Creek 2 (2017 site)

Location (GDA94): Easting: 627329; Northing: 5987416

Date: 24 March 2023

Elevation: 1,850 m

Slope: 5 degrees

Notes: 400 m of a tributary of the upper reaches of Valentine Creek, and 400 m of Valentine Creek approx. 1.9 km south-west of Big Brassy Peak. Growing along the margin of a creek in open valley. Northerly aspect. Moist grassland/sedgeland interface. Associated species *Carex gaudichaudiana*, *Oreomyrrhis ciliata*, *Luzula modesta*, *Drosera arcturi* and *Erigeron* sp.

Survey count: 79 in 2017, 92 in 2023

Jagungal – Site 20, Valentine Creek 3, big bend (2017 site)

Location (GDA94): Easting: 625826; Northing: 5992181

Date: 24 March 2023

Elevation: 1,755 m

Slope: 5 degrees

Notes: 300 m of a tributary of Valentine Creek at ‘Big Bend’ approx. 1.8 km north of Mawsons Hut. Growing in valley with braided small creek. Easterly aspect. Growing in bog. Associated species *Sphagnum cristatum*, *Richea continentis*, *Carpha nivicola*, *Carex gaudichaudiana*, *Poa costiniana* and *Empodisma minus*.

Survey count: 37 in 2017, 52 in 2023

Jagungal – Site 21, Valentine Creek 4 (2017 site)

Location (GDA94): Easting: 627724; Northing: 5991272

Date: 24 March 2023

Elevation: 1,850 m

Slope: 5 degrees

Notes: Upper reaches of a tributary to Valentine Creek, approx. 900 m south-east of Cup and Saucer. Alpine bog/grassland interface, growing adjacent to creek. Associated species *Sphagnum cristatum*, *Poa costiniana*, *Brachyscome obovata*, *Epilobium billardierianum*, *Carex gaudichaudiana*, *Oreomyrrhis ciliata*, *Ranunculus pimpinellifolius*, *Empodisma minus* and *Ranunculus dissectifolius*.

Survey count: 19 in 2017, 25 in 2023

Jagungal – Site 22, Valentine Creek 5 (2017 site)

Location (GDA94): Easting: 624874; Northing: 5990987

Date: 24 March 2023

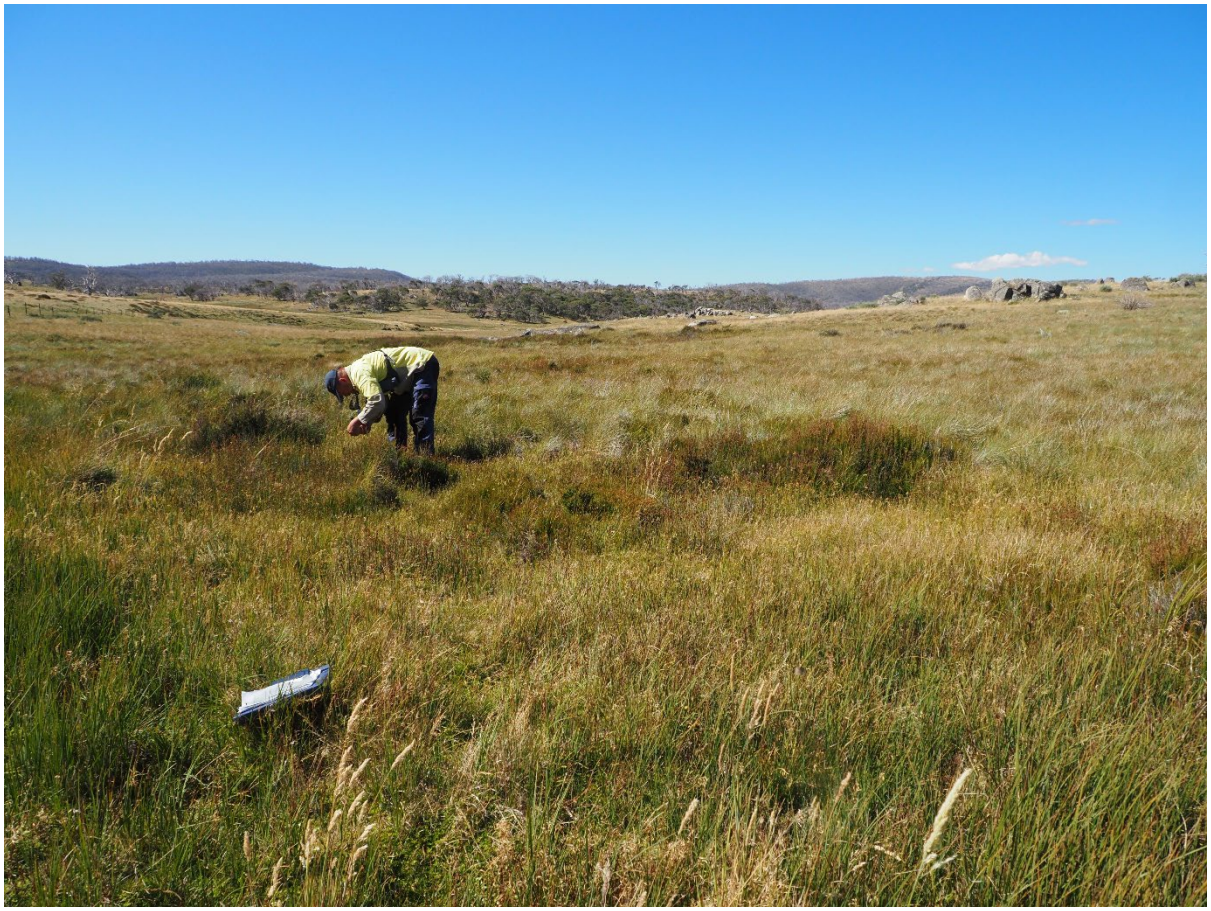
Elevation: 1,740 m

Slope: 5 degrees

Notes: Side drainage to Valentine Creek, approx. 1.35 km west of Mawsons Hut. Growing next to small unnamed creek. Associated species *Empodisma minus*, *Asperula gunnii*, *Gonocarpus micranthus*, *Poa costiniana*, *Carex gaudichaudiana* and *Senecio* sp.

Survey count: 30 in 2017, 24 in 2023

Jagungal – Site 32, Patrick's Paddock (new site)



Location (GDA94): Easting: 634844; Northing: 6001280

Date: 10 March 2023

Elevation: 1,450 m

Slope: 5 degrees

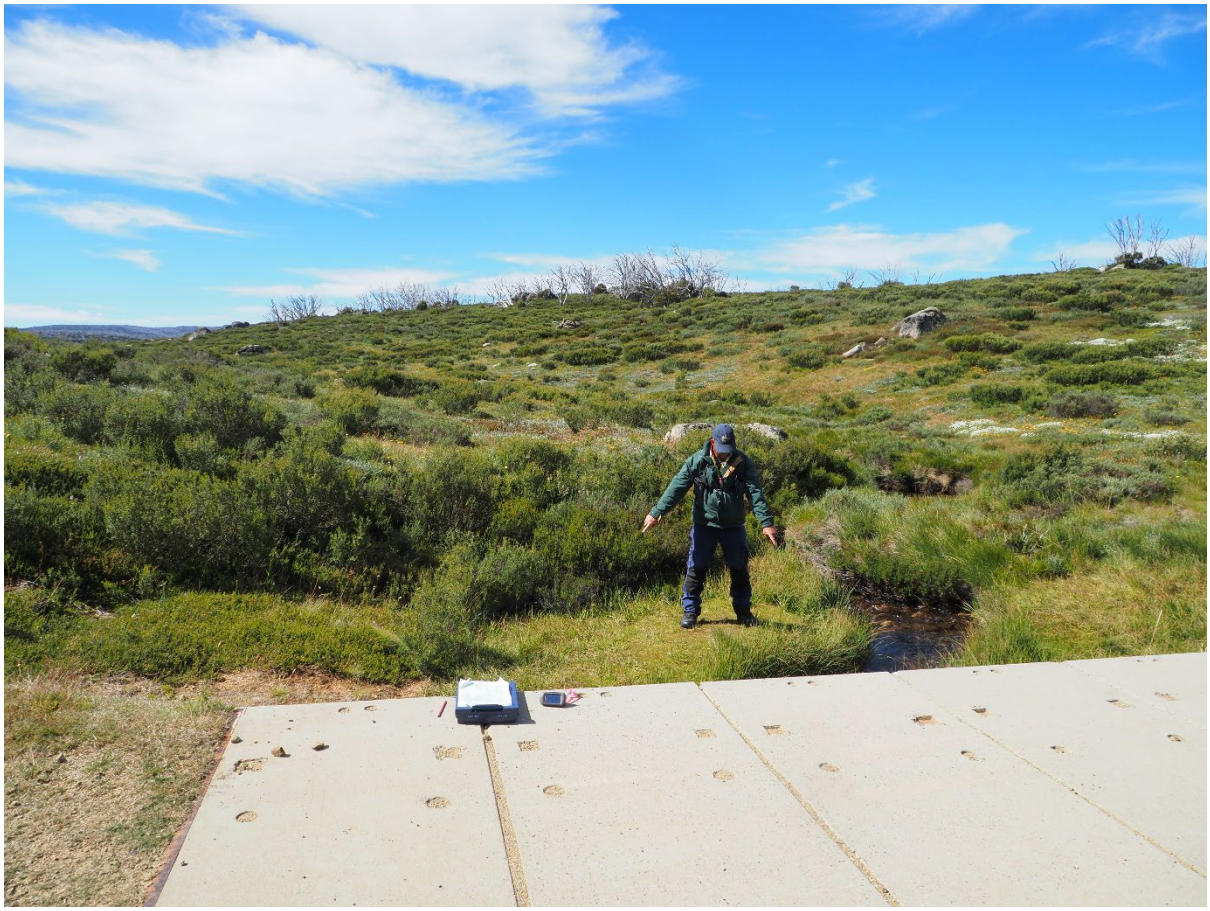
Notes: 3.4 km ESE of Spencers Peak, Kosciuszko National Park. In area called Patrick's Paddock. Growing on edge of creek that flows into the upper reaches of the Gungahlin River in the middle of a treeless plain. Found in small area 3 m x 4 m.

Associated species *Carex gaudichaudiana*, *Empodisma minus*, *Baloskion australe*, *Epacris glacialis*, *Oreomyrrhis ciliata*, *Epilobium billardierianum* subsp. *hydrophilum*, *Hydrocotyle algida*, *Poa costiniana*, *Ranunculus* sp., *Euchiton sphaericus* and **Holcus lanatus*.

Survey count: 2 in 2023

*exotic species

Jagungal – Site 35, Toolong Range (new site)



Location (GDA94): Easting: 621986; Northing: 6004693

Date: 10 March 2023

Elevation: 1,450 m

Slope: 5 degrees

Notes: Eastern side of the Round Mountain fire trail at creek crossing. Site is 2.6 km south-east of Mount Toolong summit, Kosciuszko National Park. Growing on edge of creek that flows into the Tumut River. Found in small area 6 m x 6 m.

Survey count: 3 in 2023

Perisher – Site 23a, Perisher Valley, unnamed creek (2017 site)

Location (GDA94): Easting: 625805; Northing: 5969697

Date: 8 March 2023

Elevation: 1,740 m

Slope: 5 degrees

Notes: Small tributary draining to Perisher Creek, *Sphagnum* bog previous disturbance from the adjacent Perisher ski resort car park. Associated species *Carex gaudichaudiana*, *Carex echinata*, *Empodisma minus*, *Sphagnum cristatum*, **Agrostis capillaris* and **Festuca rubra.*

Survey count: no survey count in 2017, 35 in 2023

*exotic species

Perisher – Site 23b, Upper Perisher Creek, alpine bog (2017 site)

Location (GDA94): Easting: 648912; Northing: 5938947

Date: 21 February 2017

Elevation: 1,745 m

Slope: 5 degrees

Notes: Located in an alpine bog 20 m from Perisher Creek, associated species *Sphagnum cristatum*, *Carex echinata*, *Carpha nivicola.*

Survey count: no survey count in 2017, 33 in 2023

Perisher – Site 24, Betts Creek (2017 site)

Location (GDA94): Easting: 623323; Northing: 5967466

Date: 8 March 2023

Elevation: 1,764 m

Slope: 5 degrees

Notes: Survey 1.8 km upstream from Kosciuszko Road bridge over Betts Creek. Associated species *Sphagnum cristatum*, *Carex gaudichaudiana*, *Carex echinata*, *Empodisma minus*, *Carpha nivicola*, *Epacris microphylla*, *Brachyscome stolonifera*, *Drosera arcturi*, *Oschatzia cuneifolia* and *Oreomyrrhis ciliata.*

Survey count: no survey count in 2017, 462 in 2023

Perisher – Site 25, Spencers Creek

Location (GDA94): Easting: 621859; Northing: 5967416

Date: 8 March 2023

Elevation: 1,730 m

Slope: 5 degrees

Notes: Survey 300 m upstream from Kosciuszko Road bridge over Spencers Creek. Associated species *Sphagnum cristatum*, *Carex gaudichaudiana*, *Carex echinata*, *Empodisma minus*, *Carpha nivicola*, *Epacris microphylla*, *Brachyscome stolonifera*, *Drosera arcturi*, *Oschatzia cuneifolia* and *Oreomyrrhis ciliata.*

Survey count: no previous survey, 59 in 2023