

Plantago nupera Menkins (Plantaginaceae), a new species from the basaltic uplands of the southern Darling Downs, Queensland

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Summary

Menkins, I.L. & Forster, P.I. (2023). *Plantago nupera* Menkins (Plantaginaceae), a new species from the basaltic uplands of the southern Darling Downs, Queensland. *Austrobaileya* **13**: 20–33. *Plantago nupera* Menkins is described as a new species. It is a grassland or grassy woodland specialist from the basaltic uplands on the Darling Downs of Queensland where it has a restricted distribution in the area encompassing Allora, Clifton and Maryvale. The new species is illustrated, with notes provided on its distribution and habitat, a suggested conservation status, and etymology. *Plantago* L. comprises 12 species in Queensland with seven of these being native. An identification key to these species is provided.

Key Words: Plantaginaceae; *Plantago*; *Plantago nupera*; flora of Australia; flora of Queensland; Darling Downs basalt flora; new species; taxonomy; identification key; conservation status

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Introduction

Plantago L. with *c.* 250 species (Rahn 1996; Rønsted *et al.* 2002; Hassemer *et al.* 2019; Shipunov *et al.* 2021) comprises both annual and perennial herbs. The genus has a cosmopolitan distribution, although with a concentration of species in temperate regions or at higher altitudes in the subtropics and tropics (Rahn 1996; Hassemer *et al.* 2019; Shipunov *et al.* 2021). Many of the most widespread species occur as naturalisations in Australia, hence the genus can be falsely construed as comprising predominantly alien species (WOA 2016; Blake 2020). Despite this, 24 of the 33 species that occur in Australia are considered native (Briggs 2022). Many of the Australian species have limited distributions in restricted habitats (Briggs *et al.* 1977). *Plantago* has been divided into five subgenera with further division into sections (Shipunov *et al.* 2021). The native Queensland species are all classified in *Plantago* section *Mesembrynia* Decne., whereas the naturalised species belong in other subgenera and sections (Table 1).

Speciation in *Plantago* is complex, involving polyploidy (Ishikawa *et al.* 2009; Meudt 2011, 2012), inbreeding (cleistogamy) and outbreeding (chasmogamy), often with admixtures of the two (Hassemer *et al.* 2020). Genomic evolution is inferred to have been quite rapid, based on plastome data that indicates considerable upheaval resulting in rearrangements driving hypermutations (Mower *et al.* 2021).

The seeds of *Plantago* species are coated with mucilage and this has been postulated to aid long range dispersal events by birds resulting in subsequent radiation (Rønsted *et al.* 2002; Tay *et al.* 2010; Ahlstrand *et al.* 2018). Local dispersal events are, however, more likely from ground dwelling animals (especially insects), and wind or water. Pollination, where it occurs, can be by wind, insects, or a combination of the two (Abrahamczyk *et al.* 2020), although the majority of species are probably wind pollinated (Hammer 1978). This feature, together with widespread self-compatibility is thought to have enabled colonisation of remote land masses (Ahlstrand *et al.* 2018).

Herbarium collections of *Plantago* were first made in Australia by Joseph Banks and Daniel Solander in 1770, then by Robert Brown in 1802–1803; however, surprisingly, none seem to have collected them in what is now Queensland. Brown (1810) named four new species based on his collections: *P. carnosa* R.Br. *nom. illeg.*, *P. debilis* R.Br., *P. hispida* R.Br. and *P. varia* R.Br. Within the geographical jurisdiction of the Queensland flora, *Plantago* was first recorded by Bentham (1870) with *P. debilis* and *P. varia* listed. Bentham's (and later Bailey's 1900) inclusion of *P. varia* in the Queensland flora was based on T.L. Mitchell's collection "In the interior". This collection is most likely represented by two sheets in herbaria at the Royal Botanic Gardens, Kew (K 000779672) and the Muséum National d'Histoire Naturelle, Paris (P 00609916) respectively. The K specimen was determined on the 31 May 1977 as *P. gaudichaudii* Barnéoud by L. Johnson; however, it appears to be *P. cunninghamii* Decne. based on our examination of the digitised specimen images. The K specimen is undated and labelled as 'Lieuten. Col... T.L. Mitchell', 'Subtropical N. Holl.' and 'aff. varia'. The P specimen was determined on 8 May 1972 as the holotype of *P. mitchellii* Decne. by B.G. Briggs, who later included this name in the synonymy of *P. cunninghamii* (Briggs *et al.* (1977)). The P specimen is also undated and labelled as 'Cpn Mitchell', 'Subtrop. N. Holl.' with another label stating it is from the Decaisne herbarium and with *Plantago mitchellii* on that label. Decaisne (1852), when naming *P. mitchellii* stated "In Nov. Holl. subtropica (Cap. Mitchell)" and "(v.s. in herb. Hooker)". Decaisne probably saw the material while it was still in the personal possession of Hooker, with subsequent splitting of the collection between the two herbaria. The designation of the P collection as the holotype for the name *P. mitchellii* by Briggs *et al.* (1977) should now be considered as a lectotypification in retrospect (Art. 7.11 and 9.10) (Turland *et al.* 2018) with duplicates of this collection to be designated as isolectotypes.

As noted by Gilbert (1971), Bentham "often had trouble with localities", and the Mitchell collection may have been from either New South Wales or Queensland given the lack of a date. Further investigation of Mitchell collections at BM, CGE and K is required to determine whether any other collections of *Plantago* were made by him or whether the cited collection can be dated and further localised.

The last overall taxonomic account of *Plantago* for Queensland remains that of Bailey (1900), who listed the native species *P. debilis* and *P. varia* in a direct lift from Bentham (1870), the latter once again based on Mitchell's collection from "In the Interior". Bailey (1900) also included the alien species *P. lanceolata* L. and *P. major* L. Bailey (1913) listed the same species, with the addition of an illustration of "*P. varia*". This illustration may be based on an unaccessioned BRI specimen of *P. cunninghamii* which bears a Bailey handwritten label "*Plantago varia* R.Br.", but with no other information. Domin (1929) listed only *P. debilis* as native, with *P. varia* in synonymy. By the time of the *Flora of South-eastern Queensland*, four native species (*P. cunninghamii*, *P. debilis*, *P. gaudichaudii*, *P. hispida*) and five alien species were recorded (Ross 1986). Recent *Census of the Queensland Flora* accounts (Bean 2021, 2022) enumerate 11 species, with six of these considered native, including *P. varia* once again.

To some extent, the application of names to *Plantago* species in Queensland has been haphazard over time, given that there has never been an overall revision of the Australian species. This, together with misapplications and misidentifications, has resulted in some incorrect names (e.g. *P. varia*) being applied to species locally (Bentham 1870; Bailey 1900, 1913; Bean 2019, 2021, 2022). Superficial similarity between species is largely to blame for these errors and this has not been restricted to Australian material (*cf.* Shipunov *et al.* 2021). Some species are obligate annuals, whereas others (e.g. *P. cunninghamii*, *P. debilis*), including some of the naturalised species (e.g. *P. lanceolata*)

can be annual or short-lived perennials, often exhibiting marked developmental changes in gross morphology. Investigation of the flora of the Darling Downs in southern Queensland resulted in several identification problems with *Plantago*, and the realisation that a unique taxonomic entity was present in a small area around Allora. This entity is described as the new species *Plantago nupera* Menkins in this paper.

Plantago nupera was initially suspected of being an alien species, partly because the first collections were only made in the 1990s. Species such as *Plantago media* L., *P. tomentosa* Lam. and *P. virginica* L. from *Plantago* subgenus *Plantago* were among the list of suspects based on superficially similar morphology. However, DNA analysis using the nuclear internal transcribed spacer

(ITS) region conducted by the University of Adelaide RABLAB showed that the species groups with the other native Australian species sequenced. The phylogeny suggests that *P. nupera* is most closely allied to *P. debilis* and *P. hispida* (J. Cowley, pers. comm., 2021), which are classified in *P.* section *Mesembrynia* (Shipunov 2021). By contrast, *Plantago media* is in *P.* section *Lamprosantha* Decne. and *P. tomentosa* and *P. virginica* are in *P.* section *Virginica* Decne. & Steinh. ex Barneoud (Hassemer *et al.* 2019; Shipunov 2021; Shipunov *et al.* 2021). Given the complexity of the genomics in *Plantago* (Mower *et al.* 2021), together with relatively limited overall taxon sampling, it is rather likely that allocation of species to the morphology-based sections may change in the future.

Table 1. Subgeneric and sectional placement of Queensland species of *Plantago* from Shipunov (2021, pers. comm., 2022)

Species	Subgenus and Section	Native or Naturalised
<i>arenaria</i> Waldst. & Kit.	<i>Psyllium</i> section <i>Psyllium</i>	Naturalised
<i>coronopus</i> L.	<i>Coronopus</i> section <i>Coronopus</i>	Naturalised
<i>cunninghamii</i> Decne.	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>debilis</i> R.Br.	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>drummondii</i> Decne.	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>gaudichaudii</i> Barnéoud	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>hispida</i> R.Br.	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>lanceolata</i> L.	<i>Psyllium</i> section <i>Lanceifolia</i>	Naturalised
<i>major</i> L.	<i>Plantago</i> section <i>Plantago</i>	Naturalised
<i>myosuros</i> Lam.	<i>Plantago</i> section <i>Virginica</i>	Naturalised
<i>nupera</i> Menkins	<i>Plantago</i> section <i>Mesembrynia</i>	Native
<i>turrifera</i> B.G.Briggs, Carolin & Pulley	<i>Plantago</i> section <i>Mesembrynia</i>	Native

Materials and methods

Measurements and descriptions are based on observations of plants in habitat and in cultivation in a common garden situation at Oakey, Queensland by ILM, herbarium collections at the Queensland Herbarium (BRI) and type collections of *Plantago* available online via the JSTOR Global Plant

website by PIF. Results from phylogenetic analysis using ITS sequence data were kindly supplied by J. Cowley and R. Burton of the University of Adelaide, based on samples of *Plantago nupera* from the type locality.

A binocular microscope at magnification levels 20× and 40× was used to measure and describe the smaller details.

Descriptive measurements are inclusive, e.g. 0.5–3.0 would be given as 0.5–3. In the description of hairs, stout is defined as rigid or coarse to the touch with the hairs generally relatively short and thick, while slender is defined as soft and flexible to the touch with the hairs generally long and thin.

The species key has been developed by ILM based on observation of the species and character states and data included in Kafri (1974), Feinbrun-Dothan (1978), Briggs *et al.* (1977), Briggs (1980, 2022), Meikle (1985), Jeanes (1999), Brown (1991), Hassemer *et al.* (2019), Jäger (2011), Meudt (2012), Bean (2019) and Shipunov (2021). A key to all Australian species of *Plantago* is also available (Menkins 2022).

Taxonomy

Plantago nupera Menkins, sp. nov.

Differs from *P. debilis* by the longer, more elliptic leaves, the spreading to near patent hairs on the lower portion of the scapes, the more pubescent inflorescence, the larger fruits, and the very long and persistent styles 5–9 mm long which often remain intact on pressed and dried specimens. The styles \pm straight or slightly arcuate in fresh material, becoming irregularly curled and twisted on drying. **Type:** Queensland. DARLING DOWNS DISTRICT: Forest Plain Road, 1.1 km E of Allora, 21 September 2022, *P.I. Forster PIF48254*, *G. Leiper & I.L. Menkins* (holo: BRI [2 sheets comprising 3 individual plants + spirit]; iso: CANB, MEL, NSW).

Rosulate perennial, either prostrate or upright (tufted); **taproot** stout and very well developed. **Indumentum** comprising simple, eglandular, uniseriate (comprising 3–8 cells) hairs. **Leaves** thickened but not fleshy, slightly coriaceous, in juvenile stage ovate to obovate-oblongate, by fruiting stage lanceolate to narrow elliptic (rarely broadly falcate), broadest slightly above middle of lamina, both surfaces moderately hairy, lime green or yellowish-green, rarely darker green, dull to the naked eye, glistening and minutely colliculate on magnification; **veins** (including mid-vein) numbering 3–5(–7), obvious on both surfaces, outermost obscure

if close to margins, depressed with scattered hairs on adaxial surface, prominently raised and ciliate on abaxial surface; **hairs** to *c.* 1 mm long, translucent to white, spreading, mostly patent, a few inclined, stout but soft to touch, straight or flexuous, apex aristate and often slightly deflexed; **leaf margins** entire or shallowly scalloped with 3–5 opposing pairs of small symmetrical teeth, the largest measuring 1–1.5 mm long \times *c.* 2 mm wide, each ending on the adaxial surface in a small, ill-defined tubercle measuring 1–3.5 mm diameter \times *c.* 1 mm high and surmounted by a small, unilateral tuft of short, antrorse hairs, the corresponding abaxial position forming a nearly glabrous dimple; **inner and juvenile leaves** spreading, imbricate, 3–6 \times 2–4 cm, both surfaces covered in moderately dense, short, stout, erect hairs, apex subobtuse, petiole indistinct; **outer and mature leaves** 8–22 \times 2–4 cm (including petiole), spreading, petiolate, not imbricate, each covered in moderately dense, short, stout hairs on both surfaces, **apex** sub-obtuse or broadly acute, **leaf base** attenuate, tapering very gradually to a slender **petiole** measuring 0–50 \times *c.* 4.5 mm, **axillary hairs** tufted, 1.1–6 mm long, dark golden brown, obscured by the broadened leaf base. **Inflorescence** erect or ascending, often somewhat arcuate about the middle (in rare cases coiling), narrow-cylindrical, 14–56 cm long, of two types with no obvious intermediates that often appear on the same plant, one with a short and compact spike, the other long with flowers irregularly spaced on an interrupted spike, surface dull green or dark yellowish-purple when fresh, pale brown or dull grey when dry, moderately pilose, hairs *c.* 1 mm long, white, appressed in upper part, antrorse to near patent in lower third to half; **scapes** stout, 10–30.5(–35) \times 0.2–0.3 cm, **spike** 8–26 \times 0.6–1 cm wide, typically one third to approximately equal the length of the scape, of two types, the first compact-cylindrical with close, evenly spaced flowers, the other narrow-cylindrical and elongated with irregularly spaced flowers and fruits, in both cases with flowers and fruits more widely spaced in the lowest portion of the spike; **bracts** narrow elliptic-deltoid, *c.* 2/3 length of sepals, 1.5–3.2 \times

1–1.6 mm, dull green in fresh state, dull brown in dry state, coarsely hairy, **margins** glabrous and narrowly membranous or ciliate, apex acute and slightly incurved-mucronate, **keel** somewhat thickened, either angled and distinct or broad and indistinct. **Flowers** sessile, chasmogamous, numerous; **style** straight or arcuate, sometimes kinked or twisted apically, 5–7(–9) mm long, exerted beyond corolla lobes, dark grey, rusty brown or purplish, pilose, hairs dense, short, white, patent; **sepals** elliptic, subequal, 2.2–3.5(–4) × 1.5–1.8 mm, lime green in fresh state, brown in dry state, glabrous except on keel, **apex** broadly acute to subobtusate, **membranous margins** about the same width as the keel, glabrous or with a few ciliate hairs in apical region, white with purplish highlights in fresh state, pale brown and translucent in dry state, **keel** somewhat thickened, either angled and distinct or broad and rather flat, darker than membranous margins, covered in short, coarse, antrorse hairs; **corolla tube** 1.5–2.1 mm long, inner and outer surfaces membranous, glabrous, pale brown to brown; **corolla lobes** ovate-deltoid with an acute to slightly attenuate apex, 1.3–2.1 × 1.5–1.7 mm, minutely rugose, pale brown or purplish, translucent, often darker brown or purplish black and ± opaque towards base, spreading to reflexed, rarely remaining erect, midvein distinct; **filaments** straight or slightly arcuate, 5–7 mm long, white; **anthers** apicifixed, obovate or narrowly obcordate, vertically symmetrical, 1–2 × 1–1.5 mm, pale creamy brown or yellow with purplish margins; **anther connective** 1/20th to 1/3rd the total width of the anther at its widest point, both surfaces greenish-yellow or creamy white, abaxial surfaces of the **thecae** cream to yellow with purplish margins, adaxial surfaces purplish throughout or cream to yellow with purplish margins, **inner thecal margins** vertical, incurved, adpressed upon the connective, **outer thecal margins** slightly wavy, narrowly rounded in outline, rupturing along the stomium, apex obtuse and purplish, base mucronate and deep purple. **Fruit** a pyxis, bilocular, ovoid-conical to subglobular, 3–4.8 × 2.5–2.6 mm, asymmetrically and partially

contracted in upper portion, tapering to apex; **lid** 2.5–3 × 2–2.1 mm, creamy brown or golden-brown, surface minutely rugose with 5 or 6 obscure but evenly-spaced vertical impressions, **apex** tapering acutely to a shrivelled, acuminate-attenuate mucro or cusp that is 1–1.5 mm long, of similar shape to the spike on a pickelhaube; **seeds** very obscurely rugose, with a small superficial hilum and a thin mucilaginous layer, ellipsoidal, flattened adaxially, numbering 1–4(–5) per capsule, 1.5–2.5 × 1–1.1 mm, yellowish brown. **Figs. 1–5.**

Additional specimens examined: Queensland. DARLING DOWNS DISTRICT: 24 km ENE of Clifton, Feb 1995, *Fensham 2070* (BRI); 13 km ENE of Allora, May 1994, *Fensham 1533* (BRI); Mount Pleasant Road, off Forest Springs – Goomburra Road, Forest Springs, Sep 2022, *Forster PIF48270, Leiper & Menkins* (BRI); 2.2 km E of Allora along Forest Plain Road, Oct 1996, *Bean 10853* (BRI); 7.7 km along North Branch Road, near Maryvale, Oct 1996, *Bean 10830* (BRI). CULTIVATED: Oakey (ex Forest Plain Road, 1.1 km E of Allora), Sep 2022, *Menkins s.n.* (BRI, MEL).

Distribution and habitat: *Plantago nupera* is endemic to Queensland on the eastern Darling Downs in a small area from near Maryvale in the south, to just east of Hirstglen in the north. It occurs in ungrazed, or seldom grazed situations, in relatively intact remnant grassland comprising predominantly an admixture of *Cymbopogon refractus* (R.Br.) A.Camus, *Dichanthium sericeum* (R.Br.) A.Camus subsp. *sericeum* and *Themeda triandra* Forssk. (**Fig. 6**), in relict or partly cleared grassy woodland dominated by *Eucalyptus orgadophila* Maiden & Blakely and/or *E. tereticornis* subsp. *basaltica* A.R.Bean or comprising variously *E. albens* Benth., *E. melliodora* A.Cunn. ex Schauert, *E. molucanna* Roxb., *E. nobilis* L.A.S.Johnson & K.D.Hill and *Angophora floribunda* (Sm.) Sweet. It appears to show a preference for south-facing slopes. Collectively these locations are all part of the basalt uplands of the Eastern Darling Downs; they largely equate to the eastern portion of the ‘hill woodland’ of Fensham (1998) and are part of the western foothills of the Great Dividing Range.



Fig. 1. Flowering plant of *Plantago nupera* *in situ* at type location. Photo: P.I. Forster.



Fig. 2. Rosette of flowering plant of *Plantago nupera* *in situ* at type location. Photo: P.I. Forster.



Fig. 3. Flowers in pistillate stage for *Plantago nupera* at type location. Photo: G. Leiper.



Fig. 4. Flowers mainly in staminate stage for *Plantago nupera* at type location. Photo: G. Leiper.

Within this general landscape, several *Plantago* species occur, including *P. cunninghamii*, *P. debilis*, *P. nupera* and the alien species *P. lanceolata*, although we have not observed the other species co-occurring with *P. nupera*. *Plantago lanceolata* is often in proximity, although it is invariably associated with disturbed habitats such as irregularly mown roadside verges.



Fig. 5. Flowers predominantly bisexual for *Plantago nupera* at type location. Photo: G. Leiper.

At the type locality, *Plantago nupera* is also associated with a large stand of *Discaria pubescens* (Brong.) Druce on a steep hillside that is deeply eroded and channelled (Fig. 7). Plants occur on the highest point, growing amongst tussocks of *Cymbopogon refractus* and *Themeda triandra* where the soil is crumbling and falling away (Fig. 8). The situation is quite exposed, despite being a south-facing slope and is immediately adjacent to a grassy woodland of mainly *Eucalyptus orgadophila* with occasional *E. tereticornis* subsp. *basaltica*. At a second location (Forster PIF48270 et al., BRI), the plants occur in grassy woodland dominated mainly by *E. moluccana*, mainly towards the base of a low basalt rise.

The soil where *Plantago nupera* occurs is invariably a black vertisol containing nodules of basalt and calcined clay. The pH is alkaline. These soils are basalt derived and often characterized by self-mulching,

cracking clays (black earths) (Beckmann et al. 1974). *Plantago nupera* occurs on the rather more skeletal examples of these soils that occur in the foothills of the Great Dividing Range, which typically show little or no profile development. The soils are very dark grey or brown to black in colour and often stony or possessing a granular texture. They are generally well-drained and friable when dry, but able to retain some moisture in the clay particles for extended periods after rain events.

Notes: *Plantago nupera* has gross morphological similarities to *P. exilis* Decne. from Western Australia and *P. varia* from southern temperate Australia (Table 2). It differs most noticeably from *P. exilis* in the axillary hair colour, the shorter petioles, the longer capsules and broader seeds and from *P. varia* in the axillary hair colour, hair orientation on the lower scape, the stout hairs on the adaxial leaf surface, bract shape and seed colour.

Based on ITS sequence data, *Plantago nupera* forms a monophyletic group with *P. debilis* and *P. hispida* (J. Cowley, pers. comm. 2021). *Plantago nupera* differs from *P. debilis* in the axillary hair colour, shape of the leaf laminae, form of the indumentum on the lower scape and the lower lamina surface, bract shape and longer sepals. *Plantago hispida* is disjunct in occurrence from *P. nupera*, being further south on the Granite Belt near the Queensland – New South Wales border. *Plantago nupera* differs from *P. hispida* in the axillary hair colour, form of the indumentum on the lower scape and the lower leaf lamina surface, bract shape, capsule shape and seed colour. ITS data is presently not available for *Plantago exilis* to enable a genetic comparison. *Plantago exilis* grows almost exclusively on sandy loam overlying granite formations where the pH is generally acidic, while *P. nupera* occurs on rather deeper, more clayey loams of basaltic origin and the pH is invariably alkaline.

Table 2. Morphological characters of *Plantago nupera* and allied Australia species

Species	<i>P. nupera</i>	<i>P. exilis</i>	<i>P. hispida</i>	<i>P. debilis</i>	<i>P. varia</i>
Taproot form	stout	stout	stout	slender or stout	stout
Leaf lamina shape	narrow-elliptic to elliptic	narrow-elliptic	narrow-elliptic to oblanceolate	oblanceolate or obovate	narrow-elliptic to oblong-oblanceolate
Leaf length (cm)	8–22	8.5–23	(2–)4–9(–16)	3–15(–25)	6–20
Axillary hair colour	dark golden brown	pale brown	white or pale yellow-brown	pale brown	reddish brown
Hairs on lower ½ of scape	spreading to near patent	spreading	spreading to ± appressed	appressed	± appressed
Leaf hairs on adaxial lamina surface	stout, but soft	stout, but soft	slender	slender	slender
Bract shape	narrow-elliptic deltoid	narrow-elliptic deltoid	ovate	ovate-elliptic	ovate
Sepal length (mm)	2.2–3.5(–4)	2.6–4	2.2–2.8(–3)	1.5–2.2(–3)	2.8–3.5(–4)
Corolla lobe length (mm)	1.3–2.1	1.6–2.5	1.3–1.5	0.8–1	1.5–2.3
Petiole length (cm)	0–5	6–10	0–3(–6)	0.5–10	0–5
Leaf lamina rib count	3–5(–7)	3(–5)	1–3(–5)	3–5	3–5
Pyxis shape and length (mm)	ovoid-conical to subglobose, 3.4–8	ovoid-conical, 2.8–3.5	ovoid-ellipsoid, 2.8–3.5	ovoid to subglobose, 1.7–3	ovoid-ellipsoid to subglobose, 2.8–3
Seed number in capsule, length (mm), colour	1–5, 1.5–2.5, yellow-brown	1–5, 1–1.5, yellow-brown	1–5, 1–1.5, brown	1–5, c. 1, yellow to brown	1–5, 1.5–2.5, brown

Conservation status: The relict, grassland and grassy woodland communities in the eastern foothills of the southern Darling Downs are characterised by soil types much valued for agriculture. These habitats are collectively becoming known as a minor regional centre for local speciation or species distribution rarity, and this is reflected in an increasing number of taxa being allocated conservation status listing. It has been largely cleared for agriculture, or greatly altered by land management practices or the invasion of alien species (Fensham 1998; Fensham & Fairfax 1997), particularly introduced pasture grasses and legumes (Silcock & Scattini 2007).

The handful of locations where *Plantago nupera* has been found are ungrazed by domestic stock. They are either on road reserves or land portions that are subject to indifferent management, and decreasing

in natural biodiversity and concomitant conservation values every year. This decrease in habitat quality and composition is indirectly impacted by management of adjacent agricultural land (e.g. herbicide drift, changes in moisture run off patterns, alien weed invasion) or directly by herbicide application, slashing, burning and overall clearing. Fensham (1998) found that 10% of species from his ‘hill woodland’ community were sensitive to grazing pressure and this appears to be the case for *P. nupera* based on its absence from grazed areas adjacent to known locations. *Plantago nupera* is yet to be found in the Allora Mountain Fauna and Flora Reserve that is in close proximity to the type location for the species; however, that reserve has been heavily grazed by private leaseholders in recent times with heavy infestations of alien weed species (PIF, pers. obs.).



Fig. 6. Flowering plants of *Plantago nupera* scattered *in situ* at type location (arrowed). Photo: P.I. Forster.



Fig. 7. Grassland habitat for *Plantago nupera* at type location, showing abundant flowering *Discaria pubescens*, local erosion and proximity to a road and agricultural land. Photo: P.I. Forster.



Fig. 8. Grassland habitat for *Plantago nupera* at type location, a single plant indicated by arrow. Photo: P.I. Forster.

An assessment of the Extent of Occurrence (EOO) and Area of Occupancy (AOO) for *Plantago nupera* using the GeoCat analysis tool (Bachmann *et al.* 2011), found an EOO of 298 km² and an AOO of 16 km². The species is currently known from four locations (one with two sublocations) in a highly fragmented and predominantly cleared landscape. The habitat at these locations continues to be impacted by herbicide drift from adjacent farmland, alien weed invasion and occasional grazing by domestic stock. By applying the categories of the IUCN (2012), a conservation status of Endangered (E) is suggested, based on criteria B1a,b(i–v),c(iii,iv); 2a,b(i–v),c(iii,iv); however, a formal assessment is yet to be completed.

The likelihood of returning this landscape to a pre-European state in remaining remnants is likely difficult to achieve, with management to maintain a predominantly native composition thought to be dependent on the right combination of seasonal conditions, fire and grazing pressure (Silcock & Scattini

2007). Environmental factors such as soil pH, silt, water logging and seasonal conditions in these communities were found to be more significant than fire regimes, slashing or grazing by Fensham *et al.* (2017); however, this is likely to be more relevant to larger remnants rather than in narrow road reserves with large edge effects and recurring impacts.

Plantago nupera co-occurs with at least one other threatened plant (*Discaria pubescens*) at one of its known localities. All the known locations are very small in extent, with the estimated AOO being much greater than the actual area on the ground. The *Plantago* is rather cryptic within the broader landscape and may well prove to be more widespread if all land tenures within its EOO could be adequately surveyed.

Etymology: The specific epithet comes from the Latin adjective *nūperus* (feminine *nūpera*, neuter *nūperum*) meaning “late”, “fresh”, or “recent”. The name alludes to its relatively recent recognition as a species.

Key to *Plantago* taxa in Queensland (* indicates naturalised taxon)

- 1 Plants caulescent; leaves opposite on erect, elongated, branching stems; hairs glandular ***Plantago arenaria****
1. Plants acaulescent; leaves basal, rosulate, prostrate or tufted, occasionally ascending; hairs, if present, eglandular 2
- 2 Leaves pinnately or bipinnately lobed; spikes compact with flowers appressed to axis; corolla tube sparsely hairy or hairy in lower half only ***Plantago coronopus****
- 2a Most scapes longer than leaves; bracts mostly longer than sepals; keel of anterior sepals about equal to width of membranous margins ***Plantago coronopus* subsp. *coronopus****
- 2b Most scapes shorter or equal to leaves; bracts mostly shorter or equal to sepals; keel of anterior sepals much wider than membranous margins ***Plantago coronopus* subsp. *commutata****
2. Leaves entire or toothed; spikes loose, or if compact then with spreading flowers; corolla tube glabrous throughout. 3
- 3 Flowers cleistogamous; corolla lobes erect; anthers not exerted . . . ***Plantago myosuroides****
3. Flowers chasmogamous; corolla lobes spreading or reflexed; anthers exerted 4
- 4 Capsules 8–16-seeded; leaf bases abruptly contracted or truncate ***Plantago major****
4. Capsules up to 5-seeded; leaf bases attenuate or rounded, never truncate 5
- 5 Peduncles with a series of longitudinal, parallel grooves and ridges; spikes broad, subconical, ovate, or almost cylindrical; anterior sepals fused for at least ½ their length. ***Plantago lanceolata****
5. Peduncles without grooves and ridges; spikes cylindrical; anterior sepals free or nearly so 6
- 6 Spikes narrowly cylindrical, elongating and lax at maturity; small capsules to 3 mm long, often well interspaced, particularly in lower half to two-thirds ***P. debilis***
6. Spikes cylindrical, upright at maturity; capsules larger, 3.3–6 mm long, typically close together 7
- 7 Leaves more than 15 times longer than wide ***Plantago gaudichaudii***
7. Leaves rarely more than 5 times as long as wide 8
- 8 Plants annual; bracts and sepals glabrous or with few hairs along the keels 9
8. Plants perennial; bracts and sepals with numerous coarse or soft hairs along the keels 11
- 9 Mature pyxis ovoid, obovate, or ellipsoid, 2.5–5 mm long, dark purple or dark brown; apex acute to subobtusate; plant of arid and semi-arid floodplains but generally not of swampy ground. ***Plantago drummondii***
9. Mature pyxis obovate-pyriform to pyriform, 1.5–2.5 mm long, pale brown or tinged a purplish red; constriction and taper symmetrical or asymmetrical in outline; apex acute or truncate 10

- 10 Pyxis obovate-pyriform, broadly constricted in upper third to half and tapering to apex; constriction and taper symmetrical or asymmetrical in outline; apex acute, not quadrangular or lobed; plant mostly of inland colluvial and alluvial plains, preferring more fertile soils in natural grasslands **Plantago cunninghamii**
10. Pyxis prominently pyriform with the narrowest part forming a cylindrical beak above mid-point; beak generally parallel in outline or with an additional slight compression around the middle; apex truncate, quadrangular, and minutely lobed; small plant of mostly impoverished soils in inland regions, e.g. on hard, stony or sandy ridges and plains, and on claypans and “scalds” **Plantago turrifera**
- 11 Small plants; spikes 1–6 cm long; bracts ovate, minute, 1–1.9 mm long, less than half the length of the sepals; hairs in leaf axils short, to c. 2 mm long, whitish, pale brown or pale yellowish-brown; pyxis ovoid-globular to ovoid-ellipsoid. Confined to the extreme SE of the Granite Belt east of Wallangarra where it has been collected from crevices in rock pavement, but possibly to be found elsewhere on the Granite Belt **Plantago hispida**
11. Robust plants, spikes 8–26 cm long; bracts narrowly elliptic-deltoid, 1.5–3.2 mm long, c. 2/3 the length of the sepals; hairs in leaf axils long, 2–6 mm long, dark golden brown; pyxis ovoid-conical to subglobular. In ungrazed or seldom grazed grassland on the basaltic slopes of the extreme south-east of the Darling Downs, but possibly found elsewhere in similar habitat type. **Plantago nupera**

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