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The forgotten annual forbs of Victoria's basalt plains grassland

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Comparison of historical data with recent surveys of grasslands across Victoria's basalt plain reveals a substantial decline in native annual forbs. Eleven of the 35 species once common in this ecosystem have not been recorded for decades. The near loss of a lifeform from an ecosystem should ring alarm bells, but it seems the warning has passed largely unnoticed. Is this due to shifting baseline syndrome'? What has caused this quiet decline in biodiversity, and what does it teach us about management and restoration?

Key words: *decline, extinction, historical data, plant life form, prairie, steppe, Themeda*, therophytes.

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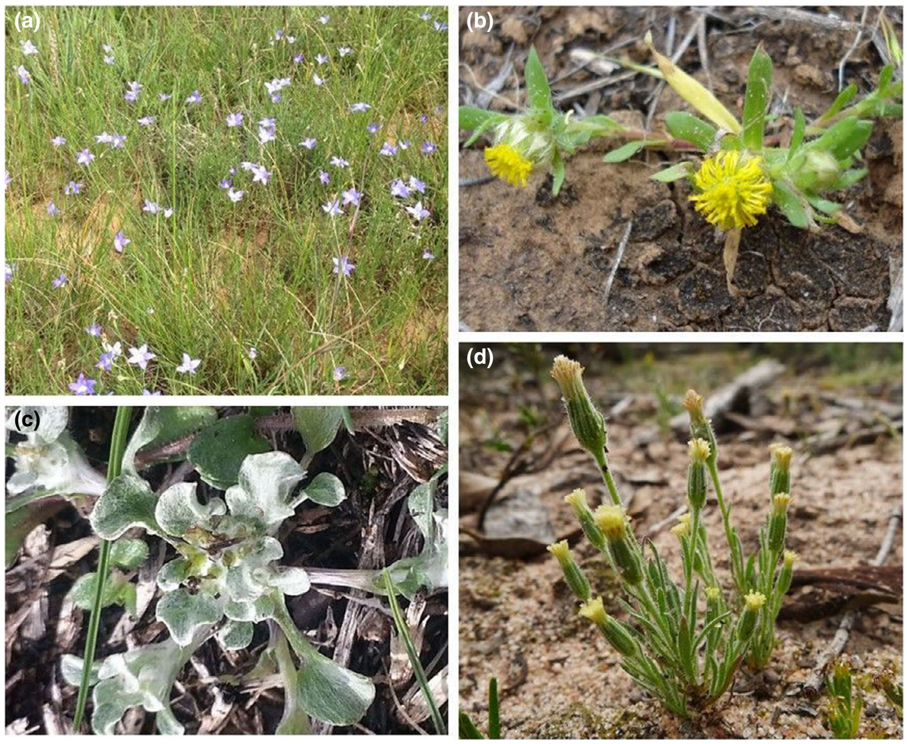

Figure 1. Four native obligate annual species once common in basalt grassland. (a) *Wahlenbergia victoriensis* on clay soil at Mount Cottrell (Photo SJS); (b) *Triptilodiscus pygmaeus* on clay soil at Melton (Photo: SJS); (c) *Stuartina muelleri*, Chepstowe (Photo GSW); (d) *Millotia tenuifolia*, now possibly extinct in the grassland community, persisting on sandy soil near Natimuk (Photo: JWM).

Native Annual Forbs were Once Abundant and Rich

The native grassland of Victoria's basalt plains (hereafter 'basalt grassland') is one of the most well-documented vegetation communities in Australia, with a steady stream of accounts describing its flora published over the last century. These valuable descriptions allow us to assess changes to the composition of the grassland over time.

The earliest detailed floristic accounts (Sutton 1917; Patton 1935) are striking in their inclusion of numerous obligate annual native forb species (therophytes). Such species are generally small and adapted to die after seeding in late spring or summer and then to germinate when autumn rains fall. Such species were clearly a prominent and obvious part of the flora.

In the earliest comprehensive list for the community (the 'grass-steppe' around Melbourne, Sutton 1917), 20% of all the native forbs listed as being 'common' were annual (24 of 121 forb species). In Patton's (1935) list of plants 'commonly found' in the 'steppe', 18% of the forbs are annual (7 of 46 common species).

Table 1 lists the species of native obligate annuals that clearly occurred in the grassland. The list is based largely on the early published accounts. We also include several additional species, based on our own observations, and – in the case of Downy Daisy (*Brachyscome debilis*) – on the strength of nineteenth-century grassland specimens (MEL 0236790A, MEL 0116055A). Table 1 also includes relevant entries from the checklist of Carr (1999) and the Flora of Melbourne (Bull & Stolfo 2014) which aggregate numerous surveys spanning more than a century (but do not describe a particular time period).

It is apparent that a few families contributed most of the obligate annual forb species, notably the daisies (Asteraceae), a family represented by a rich "inch flora" (i.e. very tiny species) of 15 species. Apart from the Asteraceae, only the Apiaceae, Crassulaceae and Gentianaceae have more than two representatives. This is consistent with the annual flora found in fertile grassy systems elsewhere in Australia (Morgan & O'Brien 2012). Many of the species recorded for the basalt grasslands also occur in more arid grasslands and woodlands, with the basalt grasslands representing the most mesic limit for many of the species. Figure 1 shows some examples of the annual native forbs.

Assessing the Recent Status of Native Annual Forbs

In order to assess the persistence of native annual forbs into recent decades, we examined several lists from more recent surveys. We included the surveys of Groves (1965) and McDougall (1987), who both provided inventories of the ecosystem in the eastern portion of the basalt plain.

We also examined all quadrats in the Victorian Biodiversity Atlas that represent basalt grassland. To ensure we only used relevant quadrats, we selected all quadrats within the Victorian Volcanic Plains bioregion which were treeless and contained native grasses and then excluded plots with obvious wetland and saltmarsh species (indicated by the presence of the genera *Phragmites*, *Eleocharis*, *Marsilea*, *Tecticornia*, *Salicornia*). We included all remaining quadrats (n = 595). These quadrats come from many different studies (and therefore have no unified sampling strategy), including both inventory (largely) and repeat-monitoring (very rarely) studies, and span the years 1983–2019. The quadrats sample land uses ranging from intact grassland to intensively grazed paddocks and are spread across the bioregion with a concentration to the west of Melbourne. Table 1 summarises the results. It also includes anecdotal observations from the authors (collectively with >70 years of field experience, spanning 27 years).

Native Annual Forbs have Declined

Our assessment is that the native annual forb flora of the basalt grasslands has declined markedly since invasion by Europeans. Despite reasonable survey effort and ongoing curation, the Victorian quadrat database reveals that of the 19 species considered 'not rare' by Sutton in 1917, 13 have never once been captured in a quadrat across the ecosystem. Quadrats only sample small areas and may miss infrequent species, but we find a similar pattern in the published lists compiled for larger areas: nine species common in 1917 have not been recorded since 1917. The proportion of forbs that are obligate annuals has declined in each subsequent inventory of the grassland flora, from 20% in 1917 to 8% in 1987. Our recent field observations suggest that of the 35 annual forb species known to have occurred, 11 are possibly extinct in the grassland ecosystem. In our experience, only five annuals remain widespread and common: Spreading Crassula (*Crassula decumbens*), Austral Stonecrop (*Crassula sieberiana*), Rough-leaved Goosefoot (*Dysphania pumilio*), Blue Heron's-bill (*Erodium crinitum*) and Jersey Cudweed (*Laphangium luteoalbum*).

These figures are sufficiently stark to allow a firm conclusion of overall decline to be drawn, but unfortunately further nuance in describing this decline is not possible with the available data.

Difficulties and Frustrations of Dealing with Old Survey Data

Dealing with old and disparate data is difficult, since we can have no control over the design or implementation of the sampling (Dunwiddie *et al.* 2014). It is important to acknowledge several significant limitations that hamper our ability to quantify the decline. The method, coverage, seasonal timing and effort of the historic surveys and the more recent quadrats are mostly not known. Very few of the surveys are repeat samples of the same location, so that direct longitudinal comparisons are unable to be made. Further, the earliest lists may not be representative of the entire grassland ecosystem, since most of the observations are from the eastern end of the volcanic plains, close to Melbourne.

We also acknowledge that our assessment is limited by subjectivity in defining which species are annual, requiring us to make a conservative

Table 1. Native annual forbs of the basalt grasslands

Species	Sutton 1917	Patton 1935	Groves 1965	McDougall 1987	Carr 1999	Bull & Stolfo 2014	Quadrats (%)	Authors
Percentage annual	20%	18%	14%	8%	–	–		
Apiaceae								
Daucus glochidiatus	Y	Y	Y		Y	Y	0.3	Very rare
Hydrocotyle callicarpa	Y				Y		–	Absent
Hydrocotyle capillaris	Y					?	–	Absent
Hydrocotyle foveolata					Y		0.3	Very rare
Asteraceae								
Brachyscome debilis						Y	–	Absent
Brachyscome perpusilla							–	Very rare
Cotula australis	Y				Y	Y	–	Occasional
Euchiton sphaericus	?	?			Y	Y	1.2	Occasional
Gnaphalium indutum					Y		–	Very rare
Laphangium luteoalbum	Y					Y	2.5	Common
Hyalosperma praecox							–	Absent
Hyalosperma demissum					Y	Y	–	Very rare
Isoetopsis graminifolia	Y (r)		Y	Y	Y	Y	0.2	Very rare
Millotia tenuifolia	Y				Y		–	Absent
Myriocephalus rhizocephalus	Y (r)	Y	Y		Y	Y	–	Very rare
Podotheca angustifolia	Y (r)						–	Absent
Siloxerus multiflorus	Y						–	Very rare
Stuartina muelleri	Y				Y		-	Very rare
Triptilodiscus pygmaeus	Y	Y	Y	Y	Y	Y	2.2	Occasional
Campanulaceae								
Wahlenbergia victoriensis	?	?					–	Very rare
Wahlenbergia gracilenta	?	?				Y	–	Rare
Chenopodiaceae								
Dysphania pumilio	Y				Y	Y	1.3	Common
Crassulaceae								
Crassula closiana					Y	Y	0.7	Occasional
Crassula decumbens var. decumbens	Y			Y		Y	3.4	Common
Crassula sieberiana var. tetramera	Y	Y		Y	Y	Y	1.2	Common
Euphorbiaceae								
Poranthera microphylla	Y				Y		–	Very rare
Gentianaceae								
Schenkia australis				Y			–	Absent
Sebaea albidiflora	Y					Y	–	Absent
Sebaea ovata	Y	Y	Y	Y	Y	Y	2.8	Occasional
Geraniaceae								
Erodium crinitum	Y	Y	Y	Y	Y	Y	1	Common
Portulacaceae								
Calandrinia calyptrata	Y						–	Absent
Ranunclualceae								
Ranunculus sessiliflorus					Y		–	Very rare
Rosaceae								
Aphanes australiana					Y	Y	–	Absent
Stylidiaceae								
Levenhookia dubia	Y					Y	–	Very rare
Stylidium despectum	Y						–	Absent

'Y' represents inclusion on a list. 'r' indicates a species that Sutton (1917) explicitly described as 'rare'. '?' represents a species which was not described at the time of survey, such that its status cannot be confirmed.

The row 'Percentage annual' records the percentage of all native forb species which were annual for a survey of a given date (the surveys of Carr (1999), and Bull and Stolfo (2014) are omitted because they are aggregate lists which incorporate older evidence).

The numbers in the column 'Quadrats' represent the percentage of all grassland quadrats (n=595) in the Victorian Biodiversity Atlas in which the species occurs.

The column 'Authors' represents the current status of each species, in the collective opinion of the authors. 'Absent' denotes a species we believe to be locally extinct in the grassland ecosystem, since none of the authors have observed this species in the grassland at any site during their careers. 'Very rare' denotes species which the authors have seen at fewer than three sites, 'Occasional' denotes species met with at few sites, 'Common' denotes species that may still be seen at numerous sites, often in great abundance.

assessment. It is arguable whether some species are annuals or short-lived perennials (e.g. *Spergularia* spp.), whether some species are natives (e.g. Common Purslane, *Portulaca oleracea*), and whether to include the numerous species which occur in wetland (fresh or saline) areas adjacent to basalt grasslands and which occasionally turn up in basalt grasslands proper. Table 1 is conservative and omits all these species. There may also be error introduced by differing opinions from previous authors about exactly which sites are 'basalt grassland'. While this is obvious at sites with basalt rocks at the surface, some sites may be difficult to interpret.

It is also important to acknowledge that the earliest data available (Sutton 1917) represent an ecosystem that had already suffered 80 years of agricultural impacts (Powell 1970). It is quite possible that the annual flora was even larger than indicated in Table 1. There are several species not listed in the earliest accounts, but which may plausibly have occurred within the grasslands. Table 2 lists these species. Such species are either vagrants (i.e. they were sometimes 'in' the community in particular unusual circumstances, but not 'of' it) or were once widespread and common in grasslands, but which suffered very early declines and evaded detection. There may also be other species that should be on our list, but were never detected and will remain ghosts lost to history.

We acknowledge that some species may remain in places we have not examined, and some of the species we list as now 'absent' from the grassland may still persist. Such oversights on our part would not detract from the general conclusion that annuals have declined. Despite the imprecision caused by the qualitative and subjective nature of the data, we consider that the sheer low numbers recorded for species that were once common provides overwhelming evidence for a general decline in the obligate annual lifeform.

Table 2. 'Ghosts and vagrants': additional native annual forbs which possibly occurred in grassland.

Species	Comment
Atriplex eardleyae	Common in inland Australia. Single specimen from 1993, Craigeburn "Growing on black basalt-derived soil on top of a low ridge." (MEL 2014554A). Likely vagrant.
Ballantinia antipoda	Extremely rare throughout its range. Two early specimens from the volcanic plains ('Werribee' 1866, MEL 0018228A; 'Skipton' date unknown, MEL 0018234A). Plausibly an occasional component of grassland, most likely stony rises or granites such as Mt Emu.
Cardamine papillata	Scattered across south-eastern Australia. Single specimen collected by Sutton labelled 'Keilor Plains', precise date unknown but possibly associated with 1917 survey; MEL 0600863A. Plausibly once a component of grassland, most likely stony areas.
Crassula colorata	Common in inland Australia. Recorded in 2 recent quadrats near Lake Corangamite and one near Ballarat. Likely vagrant.
Gnaphalium polycaulon	Common in inland Australia. Specimen from You Yangs area, late 1800s, precise date unknown; MEL 0283469A. Easily confused with other cudweeds (native and exotic) and possibly overlooked. Doubtful if native. Plausibly once a component of grassland.
Leptorhynchos waitzia	Widespread in inland Australia. Known from a single site at Lake Corangamite, described as "...largely bare, crumbling, clay slope above lake shore" (MEL 2015913A) and "...steep bank above lake, on grey coloured, fine grained soil with *Coxiella* shells" (MEL 2450973A. Plausibly once a component of grassland, but maybe always restricted to this unusual site.
Millotia muelleri	Widespread in inland Australia. Known from volcanic plains from scattered specimens and lists (e.g. MEL 2051417A), but apparently all from areas of non-volcanic soils. Unlikely a component of basalt grasslands; possible vagrant.
Millotia perpusila	Common in inland Australia. Single undated specimen labelled 'Skipton'; MEL 0712183A. Plausibly once a component of grassland.
Phyllangium divergens	Scattered in wooded areas off basalt. Single specimen labelled 'Werribee' in the 1800s, precise date unknown; MEL 0221471A. Plausibly once a component of grassland.
Rhodanthe corymbiflora	Common in inland Australia. Collected in 1906 from 'Sydenham' (MEL 0610584A; CANB 339067.1). Plausibly once a component of grassland.
Rhodanthe pygmaea	Common in inland Australia. Reported once on Werribee Plains (1981, Neville Scarlett). Plausibly once a component of grassland.
Levenhookia sonderi	Scattered in southern Australia. A few early collections are possibly volcanic plains grassland, 1893 'Hopkins River'; MEL 2256400A; 1902 'Hawkesdale', CANB 190608.1. Plausibly once a component of grassland.

Reasons for the Decline

There are several likely explanations for the decline in annual species, which are not mutually exclusive, and may reinforce each other. These can be appreciated by comparisons to other regions; both areas which have retained a rich annual flora (e.g. more arid and less productive Australian systems; Towers *et al.* 2020), and areas which have suffered similar declines in obligate annuals (e.g. relatively productive North American prairies; Dunwiddie *et al.* 2014).

The most obvious reason for the decline of native annuals is competition from cosmopolitan exotics which prosper under agriculture (grazing, elevated nutrients) and fill the niche once occupied by native annuals (Moore 1953; Moore 1970; McIntyre & Lavorel 2007; Morgan & Ebsary 2020). Such exotics include monocots such as Wimmera Rye-grass (*Lolium rigidum*), and dicots such as Big Heron's-bill (*Erodium botrys*), many of which are much larger than the

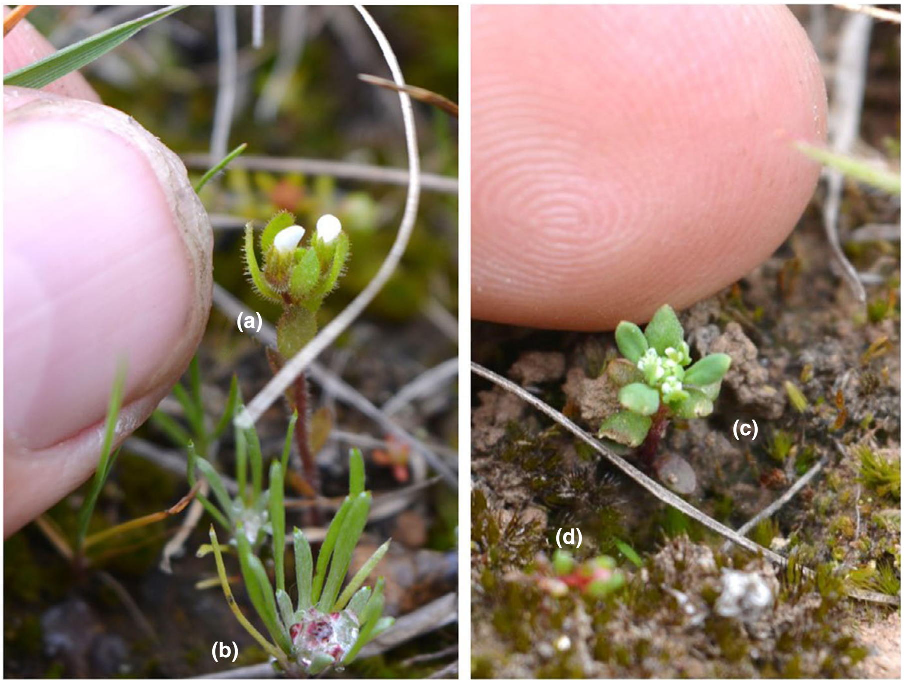

Figure 2. The diminutive size of some annual forbs in grassland, seen against a human fingertip. (a) *Levenookia dubia*, (b) *Gnaphalium indutum*, (c) *Poranthera microphylla*, and (d) *Crassula* sp. (probably *C. decumbens*). Both photographs taken near Chepstowe (GSW).

diminutive natives (see Figs 2, 3). The impact of exotic annuals is likely to be more severe in basalt grasslands compared to other grassy systems, because of the combination of relatively high rainfall (generally 500–800 mm annually) and a particularly elevated nutrient status, which together confer a competitive advantage to many exotics (Harpole *et al.* 2007). The nutrient status of the basalt plains is relatively high inherently, but has been elevated across most of the landscape by extensive and intensive grazing and high rates of land conversion to cropping with high nutrient inputs (Ierodiaconou *et al.,* 2005), which due to the diffusion of excess nutrients (particularly Phosphorous) sees entry of nutrient into remnant grassland sites from surrounding agricultural land (Morgan 1998a; Duncan *et al*. 2008). This is exacerbated by the particularly small size of most remnant sites on the basalt plains (Barlow & Ross 2001; Williams *et al*. 2005), which have high edge-area ratios and are generally surrounded by land where fertiliser is used (Fig. 4).

Competition from exotic species is mediated not only by living plants, but by the litter they produce. Field experiments in California (Coleman & Levine 2007) show that some common invasive European annuals produce particularly high litter loads and that these loads are just as important in suppressing native forb growth as competition from living plants. This is highly likely to be the case in basalt grasslands too, since many of the same high litter producing invasive species are common in Victoria. Recent glasshouse experiments have confirmed that some widespread Australian annual forbs tend to germinate relatively poorly in high litter loads, compared to common invasive species (Morgan & Ebsary 2020).

Another obvious reason for the decline is alteration to the regime of biomass build-up and removal by fire and soil disturbance, leading to a contraction in the niche occupied by annual forbs. This has been suggested as a prime reason for the decline in annuals observed in American prairies (Dunwiddie *et al*. 2014). Before colonisation, soils were likely to have been patchily but regularly and extensively turned over by small marsupials that were once common in basalt grasslands (e.g. Eastern Barred Bandicoot, *Perameles gunnii*; Menkhorst 1995) and by traditional harvesting methods of plant roots for food (Gott 1983; Gammage 2011). This disturbance may have created open niches for annuals to prosper, which declined once the native species and traditional land management declined. Rabbits have not replaced native mammals as a disturbance agent in basalt grasslands to any great extent, as they have in some other Australian grassy systems, because soils with high clay content or poor drainage are unsuitable for rabbit warrens (Williams *et al*. 1995).

Changes in fire regime are difficult to assess. Although we know that traditional indigenous management involved the subtle and extensive use of fire (Gammage 2011), we generally lack detailed data on pre-colonial fire patterns for specific ecosystems, particularly in areas such as the basalt grasslands where invasion occurred swiftly and early (but see Foreman 2020). Despite this, it is possible to recognise specific contexts where altered fire regimes have very likely had detrimental effects on annuals. In grasslands which have had grazing removed but no fire – including many remnants set aside for conservation – we know that a lack of biomass control has led to the excessive growth of Kangaroo Grass (*Themeda triandra*) (Stuwe & Parsosn 1977). It is likely that this biomass build-up contributed to the exclusion of native annuals that remained in these sites. Excessive grass competition is less of an issue in less productive grasslands, many

Figure 3. The declining niche available for diminutive annual forbs within grasslands. (a) A basalt grassland which has escaped intensive agriculture. Note the patchy but substantial areas of bare ground, the niche occupied by annual forbs, along with the dominance of native species (here *Leptorhynchos squamatus* (yellow), *Convolvulus angustissimus* subsp. *omnigracilis* (pink), *Themeda triandra* and *Austrostipa* spp. (grasses)). This site supports a large population of the rare native annual forb *Wahlenbergia victoriensis*, not clearly visible in photograph, but see Figure 1a (Photo: SJS). (b) A degraded basalt grassland which has been grazed and fertilised with superphosphate, on the same landform and only 8 km from the intact site. Note the lack of bare ground and the very high cover of exotic annuals (here mostly *Lolium rigidum*). The native *Austrostipa bigeniculata* (straw-coloured grass in photograph) persists at sufficient cover for this site to be considered a native grassland under Victorian legislation. This site is not known to support any native annuals (Photo: SJS).

of which retain their annual species. Another potential factor that may operate in specific areas is the practice of repeatedly burning grassland remnants on railway and road verges in late spring or early summer as a fire prevention measure, which occurred for most of the 20th century. This practice ceased on the railways by the 1980s after the demise of steam trains, but persists in some places on roadsides (Lunt & Morgan 2002). This practice is likely to have removed annuals from some of the most intact areas spared by agriculture, by interrupting their reproductive cycle at its most vulnerable point, when the seeds or flowers are exposed, before they are released to the ground or litter layer. While railway and road verges make up only a small proportion of the landscape, they support many prominent and important areas of remnant grasslands.

The removal of trees from the original grasslands may also have contributed to declines in native annuals. Many of the annuals listed in Tables 1 and 2 remain common in woodlands in other regions of south-eastern Australia. Early accounts confirm that the basalt grasslands once supported savannah woodlands and patches of trees (Sinclair & Atchison 2012), and it is possible that these wooded areas were the stronghold of some annual species because the trees moderated grass competition.

Trampling and soil compaction by sheep may also have contributed to the decline, particularly in cases where trampling destroyed microsites favoured by annuals, such as small soaks or gilgai areas; however, the impact of grazing should not be over-stated, since many of the annual species in Table 1 prosper under grazing regimes in other grassy systems. More recently, the millennium drought may have caused small relict populations of annuals to disappear, although it seems unlikely that rainfall changes have had a widespread impact, given that annuals are generally well adapted to rainfall variation.

We are not sure why there are a few species of annual forbs that have prospered when the other annuals have fared badly. However, we note that several of the species that do remain are relatively tall and robust and may be able to withstand competition and excessive litter accumulation (e.g. Blue Heron's-bill (*Erodium crinitum*) and Jersey Cudweed (*Laphangium luteoalbum*)), while the *Crassula* species that remain are unusual among native annual forbs in having a long-persistent seed bank, allowing them to wait while conditions are unfavourable (Morgan 1998b). Where other annuals have persisted, we believe it is either because of unusually favourable site management, or because they have been able to retreat to safe microsites which are less prone to biomass accumulation and soil disturbance, such as embankments and shallow soils on rocks.

We can Learn Something from Their Disappearance

Surprisingly, the substantial shift in species composition we describe here seems to have passed unmentioned in the literature, and possibly unnoticed by many observers, even though these grasslands remain one of the most surveyed, assessed and discussed ecosystems in Victoria. In reading the lists of Sutton (1917) and Patton (1935), it now comes as a surprise to see that the grasslands were full of annual forbs. The 'amnesia' that we suspect is difficult to demonstrate, but is perhaps evidenced by the fact that even

Figure 4. Fragmentation of grassland habitat. The aerial image shows a typical region of the Victorian volcanic plains near Balliang (centred at −37.839, 144.367), which once supported Natural Temperate Grassland. Now, grassland habitat (labelled G) is confined to small areas between large swathes of agricultural cropland. These sites are likely to suffer high nutrient loads and degrees of invasion by exotic species. In this case, these areas have remained uncropped because they are raised and rocky, in other instances remnants remain due to other factors such as location along roadsides or drainage lines, or reservation as cemeteries or recreation areas.

the best restoration programs do not include or mention annual species (Gibson-Roy *et al.* 2007) and that no annual species are mentioned in the benchmarks for assessment of the system under the Victorian 'habitat hectares' assessment system. We think it is time to remember these species, despite their tiny size, because their disappearance has implications.

First, it reminds us that annual weeds may be very damaging. Because they so rapidly filled their niche (e.g. *Vulpia* species invaded in the 1840s in western Victoria (Robertson 1899)), we no longer see their impact, and we often see them as relatively benign. This is reasonable in many places, since the asset they threaten has departed, but it should give us pause for thought when we assess their impact.

Second, the decline of the annual flora may tell us something about pre-colonial fire regimes. Historic fire patterns have become a hot topic in recent years, beyond the small community of land managers, owing to the intersection of several strands in the national conversation, namely the increase in megafires, the publication of several best-selling books emphasising how widespread, deliberate, powerful and subtle aboriginal land management was (Gammage 2011; Pascoe 2014), and the increasing recognition by governments of the importance of Traditional Owners and indigenous perspectives in land management (O'Kane *et al.* 2019; VTOCFKG 2019). Many people are now talking about how the bush used to be burnt, and what this might mean for better management in the future. The simple observation that annuals were once common tells us that winter–spring fires could not have been both frequent and extensive. If burnt before their seeds have been released, the annual flora is selected-against, because its standing reproductive effort is consumed, and since many annual species seem to lack a long-lived soil seed bank. Of course, in an intact and extensive landscape, some places could be burnt in this period in some years, but it cannot have been the rule across wide areas.

Third, the replacement of native by exotic annuals cautions us against using historic fire as a guide for future fire regimes: fire regimes that encourage an annual life-history strategy once fostered natives, but now encourages weeds. In this case, reintroducing past practices may be futile for the promotion of biodiversity because the nature of the system has changed, and the asset has been replaced by a threat. Indeed, some managers advocate burning in spring to combat exotic annuals (Lunt 1990; Prober *et al.* 2005). There are, of course, other reasons to be cautious about assuming that the past should be a guide to the future (e.g. climate change), and other good reasons to argue for the retention or reinvigoration of historic approaches (e.g. animal habitat, cultural practices). Good future management must presumably emerge from a reassessment of what we collectively know, what we collectively want to achieve, and a process of observation and dialogue to work out how to do it. Every little piece of evidence can contribute to this process.

Lastly, our apparent failure to remember a large portion of the biota in an ecosystem may reveal a 'shifting baseline' problem (Pauly 1995; Manning *et al.* 2006). For basalt grasslands, we often look to the remnants on road and railsides as our benchmarks or reference states, and as inspiration for restoration. These sites are indeed among the richest remaining, but it is likely they have been shifted by repeated late Spring burning from their pre-colonial state to a modified state where perennial herbs with underground organs have prospered (e.g. Common Everlasting, *Chrysocephalum apiculatum* subsp. *congestum*) at the expense of many annual species which have disappeared.

Forgetting about ecological phenomena diminishes our understanding of an ecosystem, and this may affect our ability to manage, restore and evaluate condition change or degrees of impact (Pauly 1995; Vera 2010). As the climate changes, impacts continue to act, and as ecosystems shift further and further away from their prior states (Sinclair *et al.,* 2019) it becomes increasingly difficult, and arguably increasingly important, to remember what we have lost.

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