

The population dynamics of *Fimbristylis blakei* Latz at the Doongmabulla and Mellaluka spring-complexes, central Queensland

Penn Lloyd¹

Summary

Lloyd, P. (2026). The population dynamics of *Fimbristylis blakei* Latz at the Doongmabulla and Mellaluka spring-complexes, central Queensland. *Austrobaileya* 16: 1–11. The extent of occurrence of the spring-endemic sedge *Fimbristylis blakei* Latz was monitored annually throughout the Doongmabulla and Mellaluka spring-complexes in the Galilee Basin in central Queensland over the 6-year period 2020 to 2025 to examine temporal change in the extent of occurrence of this poorly known species. It was found at four of the larger springs in the Doongmabulla spring-complex and in three adjoining spring wetlands at Mellaluka spring in the Mellaluka spring-complex. *Fimbristylis blakei* appears to have colonised three springs in the Doongmabulla spring-complex since 2015 and it expanded at some of these springs between 2020 and 2025. Similarly, it may have colonised Mellaluka spring between 1998 and 2013 where it is now a dominant sedge at three adjoining spring wetlands. The results provide an illustrative example of the process of spring colonisation and population expansion by a new flora species in action over a period of years.

Key Words: Cyperaceae; *Fimbristylis blakei*; Great Artesian Basin springs; Doongmabulla; Mellaluka; biogeography; wetland flora; conservation ecology

¹Biodiversity Assessment and Management Pty Ltd, Cleveland, Queensland 4163, Australia. Email: penn@baamecology.com

Introduction

Artesian springs of the Great Artesian Basin provide isolated ‘islands’ of permanent water in otherwise arid landscapes. A variety of often highly range-restricted, spring-endemic flora species have evolved to occupy the spring wetlands or have become specially adapted to the unique soil chemistry of the mineral-rich soils that surround some springs (Harris 1992; Fensham & Price 2004; Fensham *et al.* 2021, 2023). ‘The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin’ is nationally significant and is listed as **Endangered** under the *Environment Protection and Biodiversity Conservation Act 1999* due its very restricted geographic distribution and being subject to threatening processes that could cause it to be lost in the near future (DCCEEW 2023). Yet, the population dynamics of the spring flora, particularly the spring-endemics remains poorly understood. One of these spring endemics is *Fimbristylis blakei* Latz,

a densely tufted, perennial sedge with a short rhizome and erect or spreading stems to 50 cm that grows in permanently wet areas in spring wetlands (Latz 1990). *Fimbristylis blakei* was first described in 1990 when it was known only from four widely separated locations in the Northern Territory and northern Western Australia (Latz 1990). It has since been found to be widespread across northern Australia between the latitudes of 14° and 22° south, with most herbarium collections being made in the last 25 years (ALA 2025; Fensham & Price 2004). In Queensland, it is generally only known from springs of the Great Artesian Basin (GAB), at more than 18 spring-complexes, but it occurs in permanent spring wetlands outside the GAB in the Northern Territory, where it is a significant, rare species (White *et al.* 2000) and Western Australia (Fensham & Price 2004).

The Doongmabulla and Mellaluka spring-complexes are located approximately 30 km apart in the Galilee Basin in central Queensland. Surveys of the flora of the Doongmabulla spring-complex by Rod Fensham and colleagues between 1998 and 2015 recorded *Fimbristylis blakei* at only two springs in the complex: Little Moses and Joshua springs (Fensham & Fairfax 2003; State of Queensland 2021). A full floristic survey of Mellaluka spring in early February 1998 did not record the presence of *F. blakei* (Fensham & Fairfax 2003; State of Queensland 2021). The presence of *F. blakei* at Mellaluka Spring was first confirmed from a specimen collected by Simon Danielsen in April 2013 from three mature plants in the main spring wetland (ALA 2023).

Knowledge of how spring-endemic species respond to environmental variability is critical for detecting and predicting the potential impacts of threatening processes and informing adaptive management plans (Rossini *et al.* 2020). To gain a better understanding of temporal change in the extent of occurrence of a poorly known spring endemic species at spring-complexes whose flora have been previously catalogued in detail (Fensham & Fairfax 2003; State of Queensland 2021), the extent of occurrence of *Fimbristylis blakei* was monitored throughout the Doongmabulla and Mellaluka spring-complexes over the 6-year period 2020 to 2025.

Materials and methods

Annual surveys were conducted between March and June from 2020 to 2025, following the late summer flowering season when *Fimbristylis blakei* was most distinguishable.

During each survey, spring wetlands were searched on foot using the random meander survey technique (Goff *et al.* 1982; Nelson 1985) focussed on all permanent spring wetlands. Wherever *F. blakei* was found, the locations of individual plants on the perimeters of all population patches were mapped using a Trimble PG200 differential GPS to sub-metre precision. The area of occurrence was then determined as the polygon joining the outermost plant locations. The extent of spring wetland vegetation associated with each spring was similarly mapped using the method of Fensham & Laffineur (2022) whereby the perimeters of areas where the combined percentage cover of living plants of perennial wetland flora species was greater than 50% or would have been greater than 50% in the absence of feral pig or livestock impacts.

Results and Discussion

Fimbristylis blakei was found at four of the larger springs in the Doongmabulla spring-complex: Camp (**Fig. 1**), Keelback (**Fig. 2**), Geschlichen (**Fig. 3**) and Little Moses springs (**Fig. 4**). At the Mellaluka spring-complex it was found in three adjoining spring wetlands at Mellaluka spring (**Fig. 4**). The species' presence at these springs was confirmed through submission of specimens to the Queensland Herbarium, although these were not retained as vouchers. All populations were restricted to permanently wet areas within the spring wetland vegetation. The total area of occurrence each year ranged between 1.42 ha and 1.70 ha at the Doongmabulla spring-complex and between 0.53 ha and 0.71 ha at the Mellaluka spring-complex (**Table 1**).

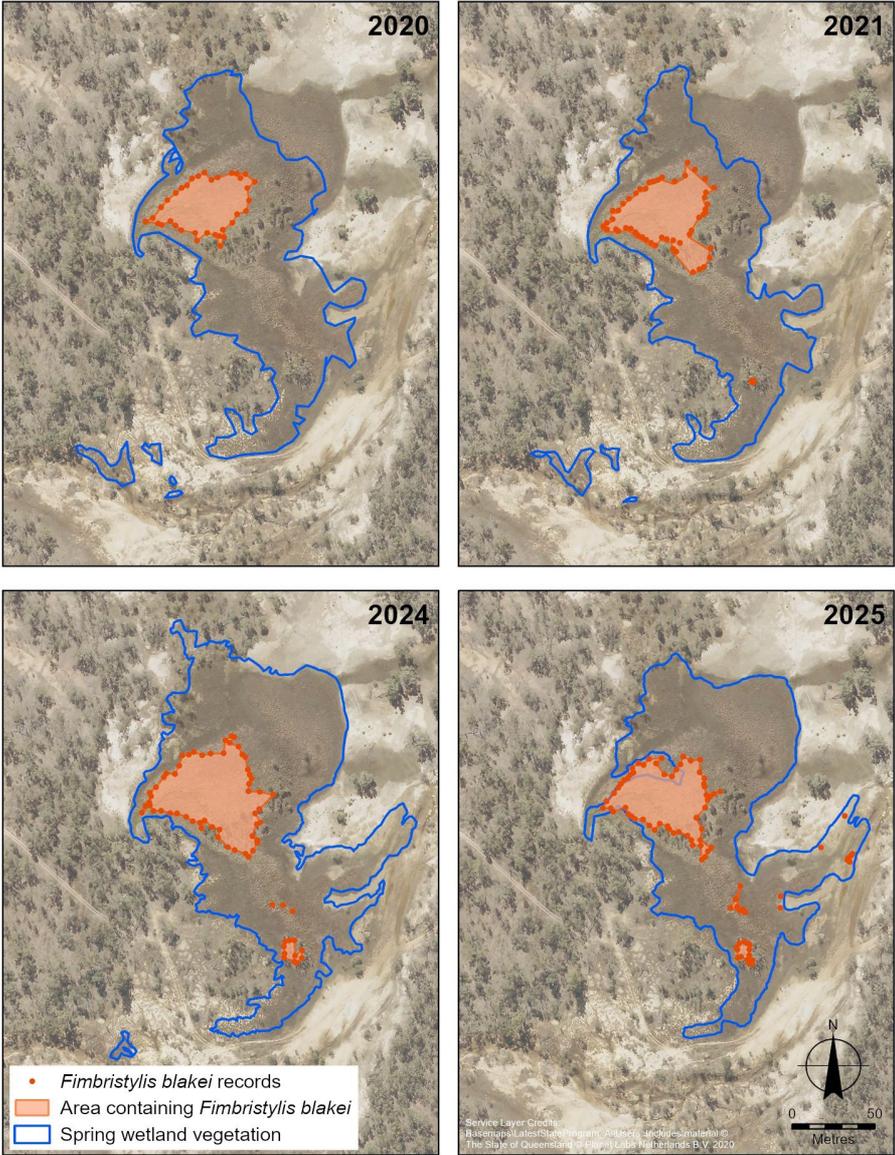


Fig. 1. Locations of records and areas occupied by *Fimbristylis blakei* at Camp spring between 2020 and 2025

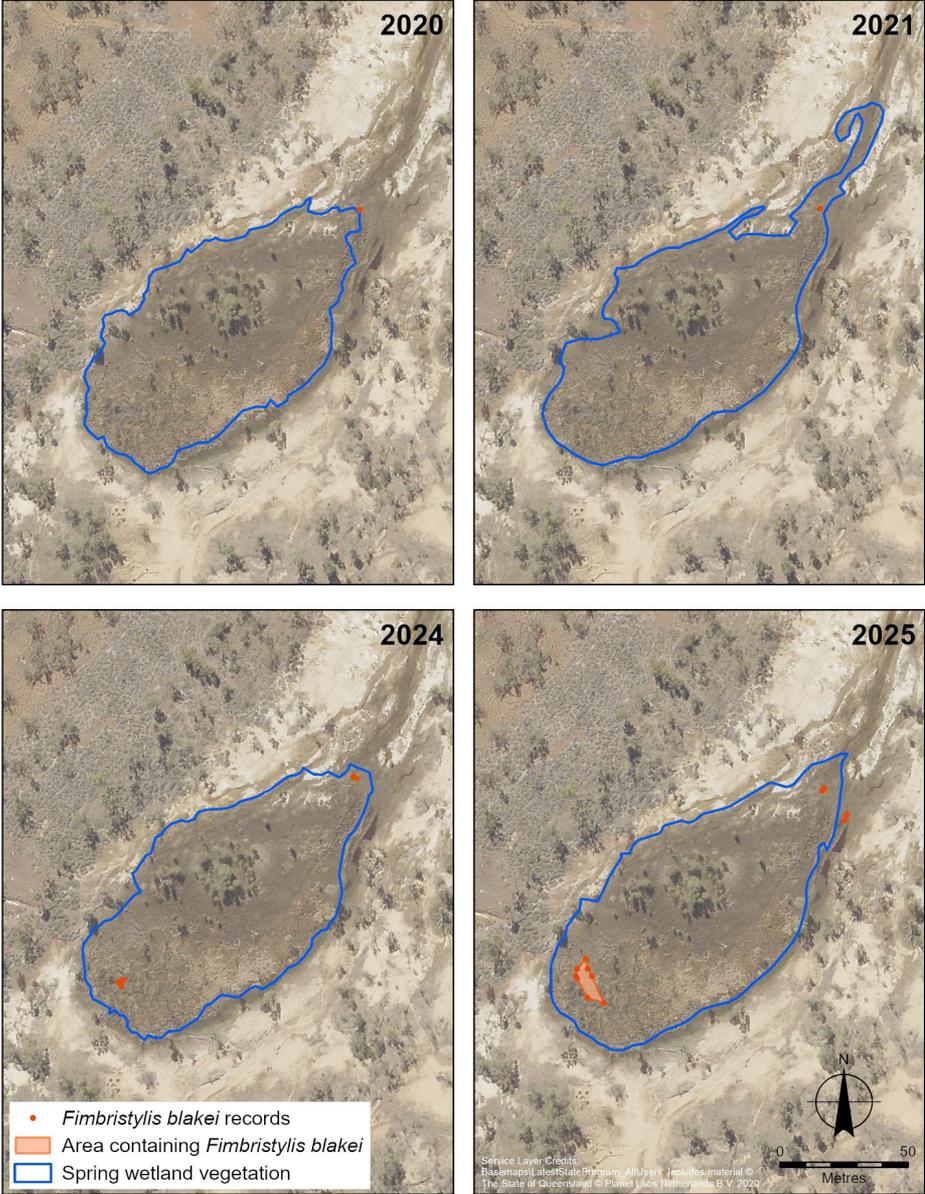


Fig. 3. Locations of records and areas occupied by *Fimbristylis blakei* at Geschlichen spring between 2020 and 2025.

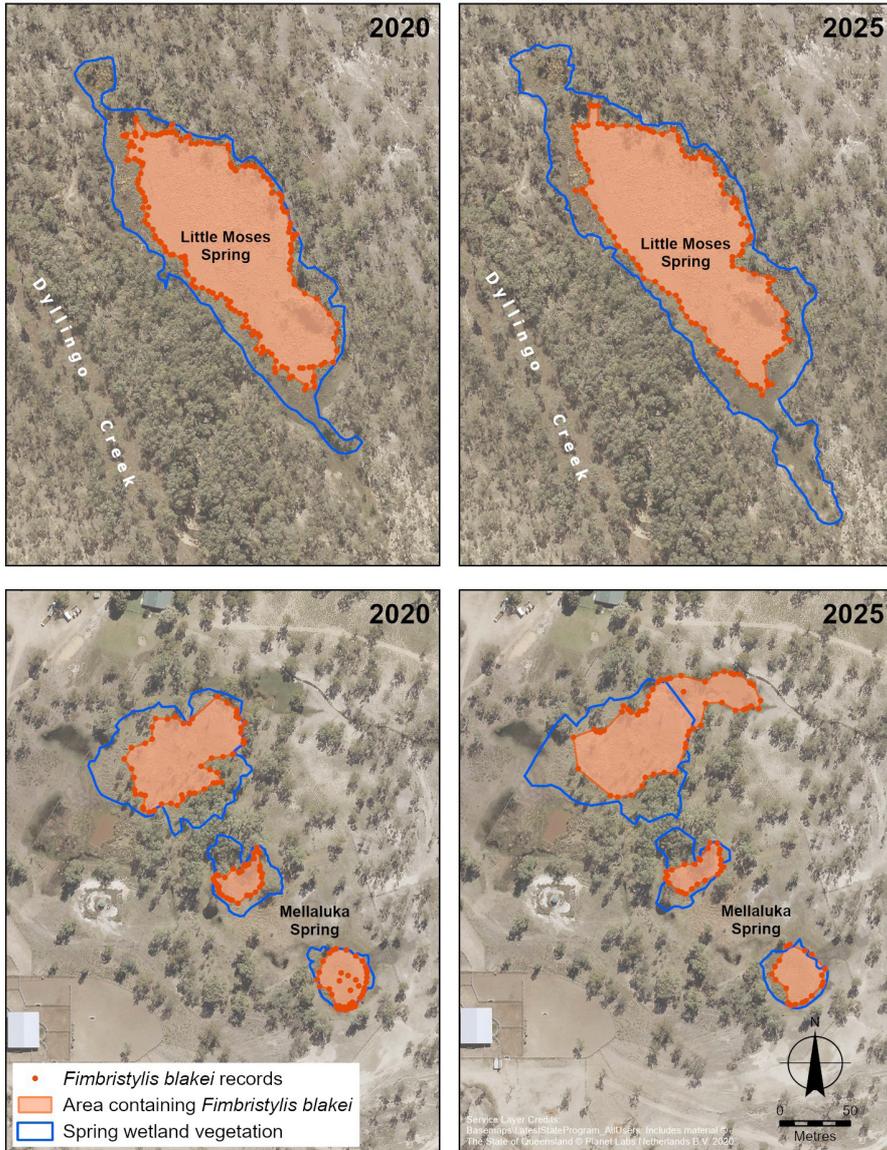


Fig. 4. Locations of records and areas occupied by *Fimbristylis blakei* at Little Moses and Mellaluka springs in 2020 and 2025.

Table 1. Summary of the area of occurrence (m²) and year-on-year percentage change (in parentheses) of *Fimbristylis blakei* at different springs within the Doongmabulla and Mellaluka spring-complexes over six years of monitoring.

Spring	2020	2021	2022	2023	2024	2025	% change 2020-2025
Little Moses	12,684	12,368 (-2.5%)	12,274 (-0.8%)	13,521 (+10.2%)	13,241 (-2.1%)	13,624 (+2.9%)	+7.4%
Camp	1,550	2,061 (+33.0%)	2,282 (+10.7%)	2,730 (+19.6%)	2,793 (+2.3%)	2,088 (-25.2%)	+34.7%
Keelback	1	32 (+3100%)	50 (+56.3%)	528 (+956%)	454 (-14.0%)	1,233 (+172%)	+123,200%
Geschlichen	0.5	0.5 (0%)	0.5 (0%)	1 (+100%)	2 (+100%)	80 (+3,900%)	+15,900%
Total (Doongmabulla)	14,235	14,461 (+1.6%)	14,606 (+1.0%)	16,780 (+14.9%)	16,491 (-1.7%)	17,025 (+3.2%)	+19.6%
Mellaluka	5,592	5,581 (-0.2%)	5,292 (-5.2%)	5,358 (+1.2%)	Not surveyed	7,102	+27.0%

At the Doongmabulla spring-complex, *Fimbristylis blakei* was one of the dominant sedges within the spring wetland vegetation at Little Moses and Camp springs, but only scattered tussocks occurred at Keelback and Geschlichen springs in the initial surveys. Over the six-year period of monitoring, the area of occurrence of *F. blakei* at the Doongmabulla spring-complex increased 19.6% from 1.42 ha to 1.70 ha. The spread of *F. blakei* was particularly apparent at Camp and Keelback springs.

At Camp spring, *Fimbristylis blakei* was restricted to a large 1,550 m² patch in the north of the spring wetland associated with outflow from the main spring vent in 2020 but a new patch of 1 m² was detected in association with a smaller spring vent in the south of the spring wetland in 2021 (**Fig. 1**); the total area of both patches increased steadily to occupy a total area of 2,793 m² in 2024 (**Table 1**). However, in 2025, the total area reduced 25.2% to 2,088 m² despite the continued expansion of the southern patch, and establishment of new plants in an expanding area of the spring wetland in the south-east (**Fig. 1**). The reduction in the overall area was due to a reduction in the northern patch as a portion of the spring wetland just north of the main spring vent dried out in response to altered

surface water flows, either due to prior feral pig damage or increased channelisation of the flow from the vent.

At Keelback spring, *Fimbristylis blakei* was restricted to several tufts occupying about 1 m² at two locations in the east of the spring wetland in 2020 (**Fig. 2**). The coverage of plants in these two patches expanded rapidly to occupy a total area of 527 m² in 2023 when several scattered tufts occupying 1 m² were also found in the west of the spring wetland, where the boundary of the spring wetland vegetation had extended considerably to the north-west by 2023 (**Table 1**). This new north-western patch continued to expand to bring the total area of *F. blakei* at Keelback spring to 1,233 m² in 2025 (**Table 1, Fig. 2**). At Geschlichen spring, *F. blakei* was restricted to a single large tuft in the northern tail of the spring wetland in 2020 (**Fig. 3**); this occurrence increased to several tufts by 2023 when several tufts were also found in the south of the spring wetland for the first time. This southern patch had expanded slightly by 2025 when a few plants had also become established at a new location on the north-eastern boundary of the spring wetland (**Fig. 3**).

At Little Moses spring, the area of occurrence decreased 2.5% from 12,684 m² to 12,368 m² between June 2020 and March 2021 due to damage caused by severe livestock pugging and feral pig digging impacts around the perimeter of the population, before recovering again to an area of 13,624 m² by 2025 (**Table 1, Fig. 4**). Feral pigs were common at Doongmabulla, observed in herds of up to 17 animals. Feral pigs fed extensively on the rhizomes of *F. blakei* and caused substantial disturbance to spring wetland vegetation at times through their digging activities (**Fig. 5**). Despite the severity of this disturbance, the spring wetland vegetation, including the coverage of *F. blakei* recovered quickly in wetter years (2022 to 2025, annual rainfall 691–960 mm compared to long-term average of 542 mm) with reduced feral pig impacts. At Little Moses spring, extensive feral pig foraging on *F. blakei* may contribute to maintaining its dominance by regularly disturbing the vegetation and preventing taller sedges such as *Eleocharis equisetina* C.Presl from becoming overly dominant and shading out *F. blakei*. The impact of animals on limiting competitive exclusion by taller wetland plant species on other spring wetland species is well documented (Fatchen 2001; Davies *et al.* 2010; Lewis & Packer 2020). At springs in South Australia, exclusion of livestock from springs led to invasion and expansion of first *Fimbristylis* species and then *Phragmites australis* (Cav.) Trin. ex Steud., the latter competitively excluding several spring endemics and *Fimbristylis* spp. over time (Fatchen 2001). Nonetheless, the feral pig impacts have facilitated the invasion of the introduced grasses *Paspalum vaginatum* Sw. and *Echinochloa crus-galli* (L.) P.Beauv. into areas occupied by *F. blakei*.

Earlier repeated surveys of the flora of the Doongmabulla spring-complex by Rod Fensham and colleagues between 1998 and 2015 recorded *Fimbristylis blakei* at only Little Moses and Joshua springs (Fensham & Fairfax 2003; State of Queensland 2021). Thus, *F. blakei* appears to have colonised or at least spread substantially within Camp, Keelback and Geschlichen springs since 2015. Camp spring lies 2 km west of Little Moses

spring, and Keelback and Geschlichen springs are each approximately 500 m north-west and south-west of Camp spring respectively. The rapid increase in the area of occurrence at Camp, Keelback and Geschlichen springs over the 6-year period from 2020 to 2025 was consistent with colonisation and subsequent expansion of the species across these spring wetlands.

The extent of occurrence was variable between years at Mellaluka spring (**Table 1, Fig. 4**), related to inter-annual changes in the wetted area and the cover and density of dominant flora species. *Fimbristylis blakei* expanded in the north-eastern corner of the largest spring wetland at Mellaluka as the wetted area expanded after 2020 but disappeared from other areas when these became densely covered by tall ground vegetation including *Imperata cylindrica* (L.) P.Beauv., *Cyclosorus interruptus* (Willd.) H.Ito, *Phragmites australis* and/or *Machaerina rubiginosa* (Spreng.) T.Koyama.

A full floristic survey of Mellaluka spring in early February 1998 did not record the presence of *Fimbristylis blakei* (Fensham & Fairfax 2003; State of Queensland 2021). The presence of *F. blakei* at Mellaluka Spring was first confirmed from a specimen collected by Simon Danielsen in April 2013 from three mature plants in the main spring wetland (ALA 2025). Thus, it is possible that *F. blakei* colonised Mellaluka Spring after 1998 and has since become a dominant sedge within its three spring wetlands. However, the original surveys in 1998 may have missed the population, perhaps mistaking sterile *F. blakei* with *F. nutans* (Retz.) Vahl that also develops robust clumps with similarly fine foliage (R. Fensham, pers. comm.). Potential vectors of dispersal of *F. blakei* between springs located 0.5 km to 2 km apart within the Doongmabulla spring-complex include feral pigs and livestock, with seeds potentially transported in dried mud caked to the animals or being defecated after prior ingestion. The dispersive potential of feral pigs is illustrated by a study in the Douglas-Daly district of the Northern Territory that found boars had mean and maximum home range sizes of



Fig. 5. Feral pig damage to spring wetland vegetation at Geschlichen spring, August 2020.

33.5 km² and 45.3 km² respectively, and the recovery of tagged animals showed average and maximum recapture distances of 3.2 km and 22.1 km respectively (Caley 1997).

Fimbristylis blakei reaches its southernmost distribution limit in Queensland at Mellaluka spring, which is located 33 km south of Little Moses spring, the closest spring with *F. blakei*. Dispersal of *F. blakei* seed over such a long distance could possibly be achieved by wetland birds, which are known to disperse the seeds of wetland plants over considerable distances (Lovas-Kiss *et al.* 2019; Green *et al.* 2023). More definitive identification of the timing and source of colonisation of different springs by *F. blakei* could be achieved through genetic analysis of the different populations in the region (*cf.* Green *et al.* 2023; Worthington Wilmer *et al.*

2008). With many additional springs located at greater distances to the south and west of the Doongmabulla and Mellaluka spring-complexes (Fensham & Fairfax 2003; State of Queensland 2021), it is possible that *F. blakei* may continue to colonise additional springs over time.

Conclusions

The apparent colonisation and rapid spread of *Fimbristylis blakei* at the larger spring wetlands included in this monitoring study, as well as short-term changes in extent in response to changes in the wetted area or dominance of other flora species suggests the floristics of the spring wetland vegetation in these springs can be quite dynamic. Fatchen & Fatchen (1993) and Fatchen (2001) similarly observed dynamic changes in spring vegetation at mound springs in South

Australia in response to changes in livestock densities and fire regimes. Fensham *et al.* (2004) also observed dynamic changes in spring wetland configuration in response to natural processes such as mound building and changes in drainage that can have important effects on community composition. Furthermore, Fensham *et al.* (2004) found that species richness increased with wetland age, suggesting colonisation by new species over time. This study provides an example of the process of spring colonisation and population expansion by a new flora species in action over a period of years. The colonisation of new springs by spring-endemic species is poorly documented. Consequently, studies examining the population dynamics of spring-endemics have made assumptions about spring colonisation and extinction rates based on spring area and isolation (e.g. Tyre *et al.* 2001, 2005) or used genetic approaches to infer dispersal (e.g. Worthington Wilmer *et al.* 2008). A long-term monitoring program at the Doongmabulla and Mellaluka spring-complexes that this study is contributing to will continue to monitor the population dynamics of *F. blakei* at these springs to further elucidate the responses of this spring-endemic to natural processes, anthropogenic perturbations and environmental variability.

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