The natural distribution and ecology of *Blandfordia cunninghamii* (Blandfordiaceae)

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Abstract: A survey covering almost all known sites and most areas of potential habitat of the rare plant *Blandfordia cunninghamii* (family Blandfordiaceae) in 2004 recorded over 4000 plants from 27 locations, with 80% of the plants in the upper Blue Mountains west of Sydney (lat 33° 40' S, long 150° 20' E), and the remainder as a disjunct occurrence on Mount Kembla in the Illawarra. Habitat requirements of *Blandfordia cunninghamii* were found to be southern aspect (SE to SW), a slope of > 30°, high rainfall (>1200 mm a year), good drainage, partial canopy cover (30-50%), and acid clayey sands with a pH of 4.5-5, at an altitude between 500 and 950 m.

Using International Union for Conservation of Nature (IUCN) parameters, we consider that the number of plants (less than 10 000), their Extent of Occurrence (940 square km), Area of Occupancy (80 km^2) are below the threshold for Vulnerable. There is observed decline in habitat and numbers and we conclude that there may be less than 10 locations (under IUCN definitions). This would mean that the species could be considered Vulnerable under IUCN Criteria.

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Introduction

Blandfordia cunninghamii is one of four species of *Blandfordia* in Australia, all confined to the eastern states, three on the mainland, and one, *Blandfordia punicea* (Labill) Sweet, in Tasmania. All are known colloquially as Christmas Bells. All three mainland species occur in New South Wales. *Blandfordia nobilis* Sm is endemic in coastal regions south of Sydney (34° S) to about Bega (36° S). *Blandfordia grandiflora* R.Br ranges from Sydney to Fraser Island in Queensland (24° S), including occurrences in the lower and middle Blue Mountains (Porter et al 1992; Johnson 1998). *Blandfordia cunninghamii* (Lindl) is a tufted perennial herb with leaves up to 1 m long. It is a rare species (Briggs & Leigh 1995), and is restricted to a narrow range of habitats in the Blue Mountains (lat 33° 40' S, long 150° 20' E) and the Illawarra areas of eastern New South Wales (Porter 1992). The objectives of the Sublime Point Bushcare Group (SPBG) survey were to provide baseline data on the current extent and abundance of *Blandfordia cunninghamii*, and to determine its conservation status and preferred habitat.

Methods

We (the SPBG) began the survey of *Blandfordia cunninghamii* in 2004 by visiting the twelve sites surveyed by Porter (1992), and two other sites identified by Porter (pers. comm.) (at the Golden Stairs, Narrow Neck and at the head of Roberts Pass, south Leura). We then extended the survey to cover as many other known occurrences and likely habitat of the species as we could.

Published accounts of the habitat of *Blandfordia cunninghamii* describe it as similar to that of other *Blandfordia* species; that *Blandfordia cunninghamii* grows in wet places, even hanging swamps - "hanging swamps" (Johnson 1996), "damp, somewhat peaty places" (Baker et al 1984), "damp places in the Blue Mountains" (Carolin & Tindale 1994; Greig 1999), "damp shallow sandy and peaty soils, often on sandstone cliff edges" (Quirico 1993), "shrub swamps and sedge swamps, seepage lines and soaks" (Benson et al 1996), "Blue Mountains sedge swamps" (Smith & Smith 1995a, 1995b), "dense swamp vegetation and wet areas in other sites" (Smith & Smith 1999).

Development of a predictive model spared us unnecessary time and effort. Initially we searched potential habitat based on published information, ie a wet area, such as a hanging swamp. We examined three steep hanging swamps, each greater than a hectare, with southerly, easterly, and westerly aspects respectively. We also examined two large sedgeswamps each with a slope of less than 1:100. In all cases the main vegetation was either Button Grass, *Gymnoschoenus sphaerocephalus* or Pouched Coral-fern, *Gleichenia dicarpa*, or both, but no *Blandfordia cunninghamii* was found.

We modified the model to include habitat outside hanging swamps, and eventually completely rejected hanging swamps and other wet places as suitable habitat. Distribution patterns appeared related to steep southern slopes. The GDA/MGA 1:25 000 Topographic Maps (Central Mapping Authority of New South Wales) enabled us to identify and examine many steep slopes with southern aspects.

Because *Blandfordia cunninghamii* occurs in high rainfall areas, the number of potential habitat sites was also reduced by only including areas with a rainfall of at least 1200 mm a year (data from the Australian Bureau of Meteorology 1991).

At each site we searched to establish the boundary of the occurrence of *Blandfordia cunninghamii*. We then covered the whole area of the occurrence with 10 x 10 m contiguous quadrats. This allowed us to count every plant. 10 x 10 m quadrats were a practical consideration because the terrain was always steep: often it was on cliff faces, though because of this the actual quadrat area (100 m^2) on the slope was recorded, not its projected horizontal area. In each quadrat we recorded the number of plants, the number in flower, the number of juveniles, and habitat parameters.

We measured slope with a clinometer (accurate to ±1°), aspect with a compass, and estimated canopy coverage according to Specht (1974). We recorded altitude, landform type, and vegetation community type. We also recorded non-habitat parameters such as the Map Grid of Australia (MGA) map references, the ownership status of the land, and time and date of survey. Details from the survey have been lodged with the library of the National Herbarium of NSW in the Royal Botanic Gardens, Sydney.

We took care to distinguish between *Blandfordia cunninghamii* and similar species with long leaves about 10 mm wide, such as *Lomandra longifolia* and *Gahnia sieberiana*. Unless new and short, leaves of *Blandfordia cunninghamii* are seldom erect: they lie flat on the sloping surface of their habitat which, being a steep slope, is always downhill. This feature is most noticeable in summer or in drought. Well-established plants may be decades old, and new leaves lie on top of a pile of still-attached dead leaves. Such piles can be 200 mm high.

Results and discussion

Natural distribution of Blandfordia cunninghamii

The main distribution of *Blandfordia cunninghamii* is in the upper Blue Mountains, along the southern cliff-top slopes between Katoomba–Leura–Wentworth Falls, a distance of about 6 km (Fig. 1). Within this relatively small area we found plants at 18 locations many of which had not been previously recorded. These new sites were found by applying our predictive model.

There are seven other Blue Mountains occurrences, isolated from the main Katoomba–Leura–Wentworth Falls concentration, and from each other, by distances greater than 2 km (Fig. 2); at Mt Tomah; Mt Wilson; Blackheath; Mt Flat Top, off the Mt Hay Road; and south of Wentworth Falls, on the Kings Tableland in a cave west of the Queen Victoria Hospital; on the southern flank of Harris Hill; and south of McMahons Point on a clifftop overlooking Lake Burragorang.

About 80 km south-east of the upper Blue Mountains, there is a major outlying population at Mount Kembla near Wollongong. There are records for two intermediate occurrences; one at Bargo River near Yerrinbool, where a specimen had been collected in January 1932, but only came to our attention in 2005 (D. Benson pers. comm.) after our survey was completed. At the other, near the Georges River in Wedderburn (reported sighting by Payne (1989), but not confirmed with a specimen,), we were unable to find any *Blandfordia cunninghamii* plants despite careful searching.

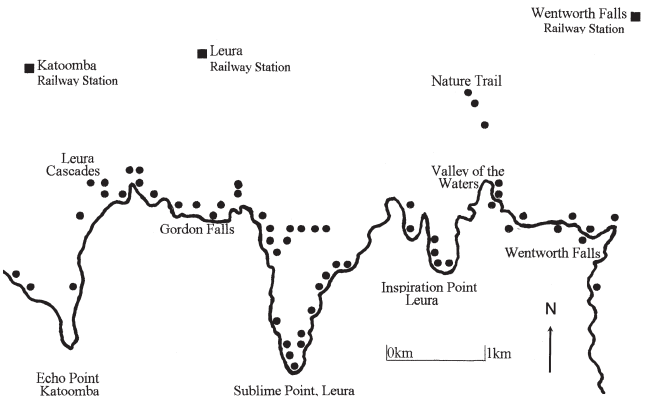


Fig. 1. The main upper Blue Mountains distribution of *Blandfordia cunninghamii* is along the southern cliff-top slopes from Katoomba–Leura–Wentworth Falls.

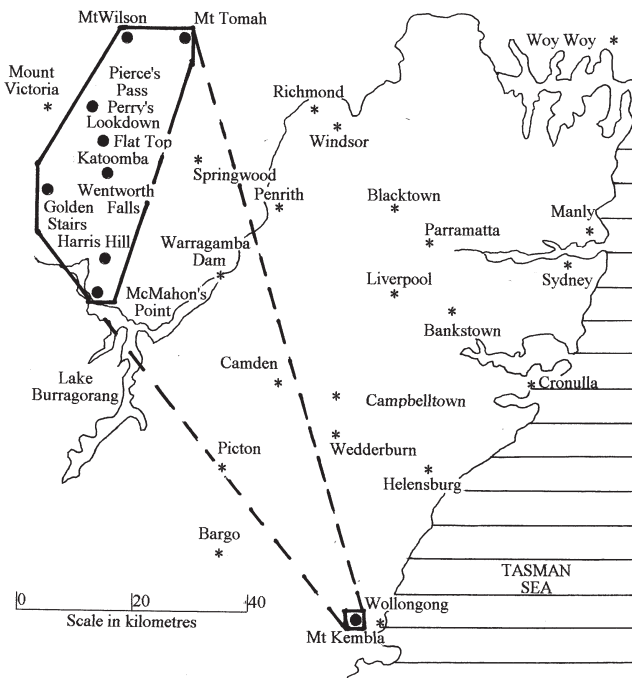


Fig. 2. Extent of natural occurrence of *Blandfordia cunninghamii* in New South Wales.

Our survey recorded over 4000 *Blandfordia cunninghamii* plants from 27 locations (Table 1). Mean population size for the 27 locations was 159 (±se=44.6) ranging from 3 plants at Popes Glen, Blackheath to 900 at Mt Kembla. Plant numbers in individual 100 m^2 quadrats ranged from 1 and 62. Mean plant densities at locations ranged from 150/ha (i.e. 1.5 per 100 m^2) at Blackheath to 2900/ha at both Mt Kembla and Harris Hill and there appeared to be a trend for greater densities in larger populations. Site areas ranged from 100 m^2 near Little Switzerland Rd and Queen Victoria Hospital at Wentworth Falls, to 3100 m^2 at Mt Kembla. The total area for the 27 sites was only 3.4 ha.

The predictive model was not always successful. We failed to find any *Blandfordia cunninghamii* on the steep slopes of the Erskine Range, or Round Hill, or Double Hill, all on Kings Tableland at Wentworth Falls. Nor did we find any on the steep slopes of Fortress Ridge, The Pinnacles, Lockley Pylon and Mt Hay, north of Leura. There were many other failures in other areas of apparently suitable habitat.

Our survey was not completely exhaustive, merely exhausting. There may well be other *Blandfordia cunninghamii* sites, especially in the Blue Mountains. Potential sites are the southern slopes above cliffs along the Kings Tableland in Wentworth Falls, on the southern flank of Mount Solitary, along the length of Narrow Neck in Katoomba, and bordering the Grose Valley from Bell to Linden. There may also be other occurrences in the Illawarra. Occurrences in any of these locations would make little difference to our measured EOO. The record for Bargo River suggests that despite the low rainfall and low altitude there may be other, probably riparian, occurrences in the middle of the long triangular EOO area (Fig. 2), and it is possible that some such sites might have been in the valleys of the Nepean and Avon Rivers immediately to the east, and now flooded by the Metropolitan Water Catchment dams (D. Benson pers. comm.)

Table 1: *Blandfordia cunninghamii* locations (IUCN locations 1-9 and subpopulations a-r), site areas, local population sizes and plant densities for 10 x10m quadrats sites recorded by SPBG in 2004.

Location (# denotes Porter site)		Site area (m^2)	No. of plants	Plant density per 100 m^2
1	Skyline Road, Mt Tomah #	300	20	6.6
2a	Pierces Pass, Mt Wilson #	800	49	6.1
2b	Perrys Lookdown, Blackheath #	400	25	6.3
3	Eastern end of Popes Glen, Blackheath #	200	3	1.5
4	Southern flank of Flat Top, Mt Hay Road, Leura	400	21	5.3
5a	Golden Stairs, Narrow Neck, Katoomba	1200	109	9.1
5b	Bonnie Doon, below old brickworks, Katoomba	400	22	5.5
5c	Prince Henry Cliff Walk, Katoomba #	1600	92	5.8
5d	Fern Bower, below Prince Henry Cliff Walk, Leura	200	6	3.0
5e	Leura Cascades #	500	33	6.6
5f	Prince Henry Cliff Walk, Gordon Falls to The Rock	1600	202	12.6
5g	Gordon Falls, Pool of Siloam, Lyre Bird Dell, Leura #	800	77	9.6
5h	Golf Links Lookout to Sublime Point, Leura #	1700	202	11.9
5i	South of Cliff View Drive, Sublime Point, Leura	6000	662	11.0
5j	Southwest side of Sublime Point, Leura	2700	436	16.1
5k	Southeast side of Sublime Point, Leura	4500	540	12.0
5l	Isobel Bowden Ridge, Leura	200	7	3.5
5m	Inspiration Point and Roberts Pass, Leura	800	78	9.8
5n	Nature Trail, Leura	900	72	8.0
5o	National Pass, Wentworth Falls #	1000	50	5.0
5p	Overcliff-Undercliff walks, Wentworth Falls #	2200	169	7.7
5q	Western side of Weeping Rock, Wentworth Falls #	300	11	3.7
5r	West of Little Switzerland Road, Wentworth Falls	100	8	8
6	West of Queen Victoria Hospital, Kings Tableland	100	15	15
7	South of Harris Hill, Kings Tableland	1500	434	28.9
8	McMahons Point, Kings Tableland	500	50	10
9	Southern flank of Mt Kembla, Illawarra #	3100	900	29.0
Totals		**34000**	**4293**	**12.6**

Comparison with Porter's 1990 survey

We were able to relocate most of Porter's (1992) 12 occurrences recorded in 1990, except for her single plant at Katoomba Falls, and her colony on Castle Head (Narrow Neck) (Table 2). At the Golden Stairs (Narrow Neck) we recorded 107 plants above and below Bottings Lookout. At the head of Roberts Pass, near Inspiration Point in south Leura, a landslide in the late 1990s wiped out most of the *Blandfordia cunninghamii* in that area; our survey recorded only 4 remaining plants of the 25 seen in 1993.

We found some large differences between Porter's figures and ours (Table 2). At Katoomba Falls, Castle Head (Narrow Neck) and Leura Cascades it is possible that heavy foot traffic from increasing tourism might have caused the reductions in numbers. The marked reductions at Perrys Lookdown and at Govetts Leap (both in Blackheath) we also consider to be real decreases. In the area between Wentworth Falls and Valley of the Waters where we found 230 plants, considerably fewer than Porter's 325, but we have no evidence to suggest why this reduction has taken place. However the increases recorded at Katoomba (Prince Henry Cliff Walk), at Leura (Pool of Siloam to Gordon Falls) and Leura (below Golf Links Lookout) are unlikely to be an actual increases since 1990; it is more likely that our survey identified occurrences missed by Porter. Overall, excluding the Illawarra population, there was no significant difference between Porter's mean number of plants/site (mean =55 ± se 27) and our figure (mean = 48 ± se 20).

The large increase in recorded numbers for the southern flank of Mount Kembla in the Illawarra represents a major increase in the area of habitat previously reported, rather than an increase in the local population since 1990. Our predictive modelling enabled identification of a long cliff line on the southern flank of Mount Kembla, (a cliff not marked on the Wollongong 1:25 000 topographic map),and found to be habitat for 900 plants. These plants grow in about a dozen parallel and vertical fissures, 5-20m high. These fissures are crowded with plants, but 90% are *Blandfordia cunninghamii* plants.

Ecological attributes

Altitude: Occurrences of *Blandfordia cunninghamii* ranged from 950 m (at Narrow Neck, Katoomba) down to 400 m elevation (at Yerrinbool). The possible site at Wedderburn (not confirmed by us), is at 100-200 m elevation.

Rainfall: High rainfall is a crucial factor. Occurrences of *Blandfordia cunninghamii* correlate strongly with records of annual rainfall of over 1200 mm, though not all high rainfall areas support *Blandfordia cunninghamii*. Pymble, a northern coastal suburb of Sydney, and Dharug National Park, west of Gosford, also experience high average annual rainfall (over 1200 mm), but there are no records of *Blandfordia cunninghamii* from these low-altitude locations. Nor was any *Blandfordia cunninghamii* found in low rainfall areas (<1100 mm per year) in our survey, despite having steep southern slopes; eg Hassans Walls near Lithgow. Wedderburn has an annual rainfall of 850 mm.

Drainage: *Blandfordia cunninghamii* does not grow in well-delineated drainage lines which may scour, but rather prefers either (a) drainage slopes which assure broad distribution of rainwater, or (b) crevices and fissures in cliffs. Leaf litter promotes slightly damp, but not wet, soils. Wet soils were encountered only immediately after heavy rain: even then they were ephemeral. Plants were not found in a Blue Mountains hanging swamp, in a sedge swamp, in a clifftop swamp, in a valley swamp or in any other variety or grading of wet places.

Table 2: Comparison of number of plants of *Blandfordia cunninghamii* reported from Porter's locations (1-12) in 1990 and revisited by SPBG in 2004.

Porter sites	Location	No of plants 1990	No of plants 2004
1	Mt Tomah (private property)	20	20
2	Pierces Pass, Mt Wilson	45	49
3	Blackheath (Perrys Lookdown)	40	25
4	Blackheath (Govetts Leap)	~30	3
5	Katoomba, Prince Henry Cliff Walk	25	39
6	Katoomba Falls	1	0
7	Narrow Neck (Castle Head)	3	0
8	Leura Cascades	13	7
7	Leura, Pool of Siloam to Gordon Falls	42	69
10	Leura, below Golf Links Lookout	60	87
11	Wentworth Falls to Valley of the Waters	325	230
12	Mt Kembla	100	900

Aspect: Our survey confirms the southerly aspect for *Blandfordia cunninghamii* previously identified (Porter 1992, Porter et al. 1992). Most plants were found in the sector 160-190° and no plants were found with an aspect further east than 135° (southeast), or with an aspect further west than 225° (southwest) (Fig. 3). None was found in the major sector of 270° from southeast, through north, to southwest.

Topography: Natural occurrences of *Blandfordia cunninghamii* occur in two broad types: either a monotonic slope of 30° or more (Fig. 4a), or a cliff-line L-step (Fig. 4b), usually at an outbreak of a claystone layer in Narrabeen Sandstone, such as the Wentworth Falls claystone. In the cliff-line L-step habitat we found *Blandfordia* plants in three topographical subtypes:

1) at the base of a cliff, in the drip zone, or in small caves behind the drip zone,

2) from the cliff base outwards and down the talus for a short distance, and

3) on vertical cliff faces and on cliff edges, in habitats where moisture is regularly available.

Slope: *Blandfordia cunninghamii* occurs on steep slopes (Porter 1992, Porter et al. 1992). A slope of at least 30° slope is an important factor in determining habitat and except for a few occurrences in small caves, no slope was less than 30°. Most slopes fell between 30-50°, but some were vertical. Although slope confers good drainage, it does not necessarily imply lack of water.

Light regimes: low levels of light appear to be an important habitat factor for growth: in sites on southern slopes and south-facing cliffs, direct sunlight hours are reduced by 50% or more in summer, and by up to 100% in winter. In

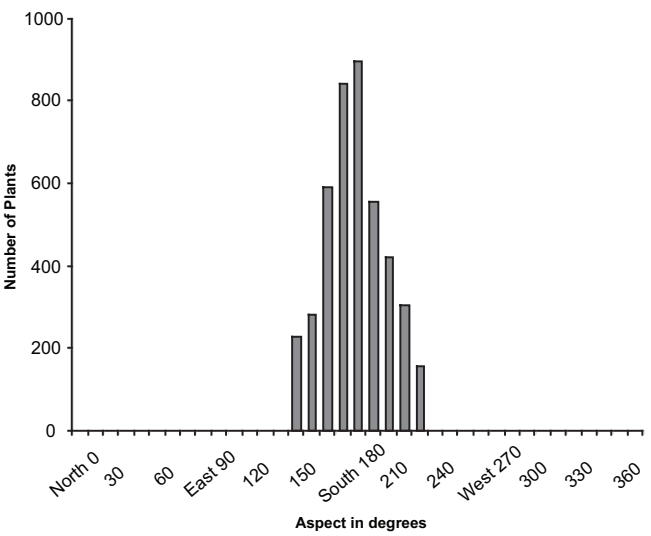
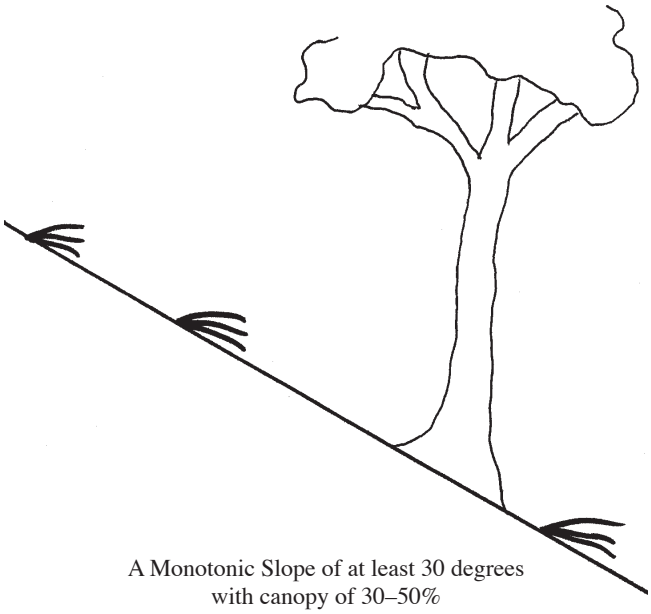


Fig. 3. Number of plants of *Blandfordia cunninghamii* recorded from 10 degree aspect sectors showing concentration on southeast to southwest sites.

Figure 4a: Monotonic slope
Blandfordia cunninghamii



A Monotonic Slope of at least 30 degrees with canopy of 30–50%

Figure 4b: L-step cliff
Blandfordia cunninghamii

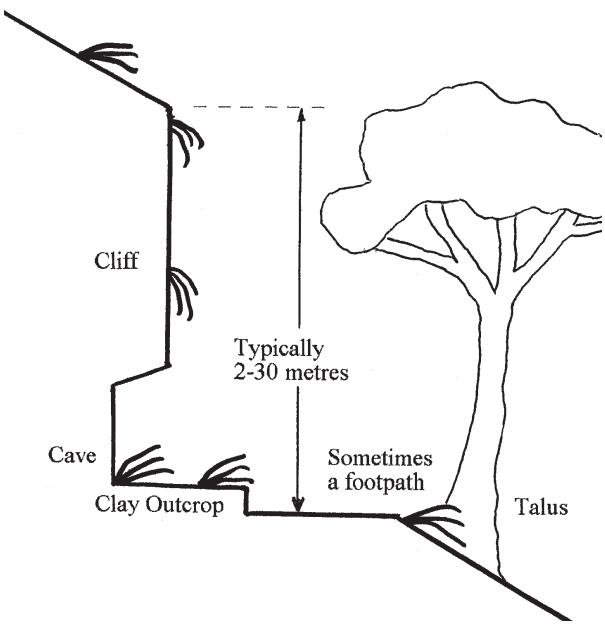


Fig. 4. Natural occurrences of *Blandfordia cunninghamii* occur in two broad landform types: either a monotonic slope of 30° or more (Fig. 4a), or a cliff-line L-step (Fig. 4b), usually at an outbreak of a claystone layer in Narrabeen Sandstone.

winter sites on a southern slope of 33.5° or more receive no direct sunlight all day (the maximum altitude of the midday sun at latitude 33.5° south is 33°). The canopy of trees and shrubs will further reduce indirect or refracted sunlight. This apparent preference for low light regimes may extend to a requirement for a cool root run, but *Blandfordia* plants were never found in the relative dark of rainforest. Where *Blandfordia* plants grow in the southern lee of a cliff or in a cave with a southerly aspect they often receive no direct sunlight all year. Yet the plants flourish, compete favourably with other species, and flower occasionally.

Canopy: In all natural occurrences of *Blandfordia cunninghamii* canopy is variable, but in the range 30-50% usually designated open-forest (Specht 1974). Even on cliffs otherwise devoid of vegetation the cliff itself presents a "canopy" of 50%. Caves also represent a canopy of about 50%. *Blandfordia cunninghamii* were not found in the canopy range up to 25% (such as woodland or open woodland), nor in the canopy range beyond 50% (such as forest or closed-forest).

Soils: *Blandfordia cunninghamii* generally grow in clayey sands of moderate acidity, with a pH of 4.5-5. Spot checks of pH were made during our survey. Many steep southern slopes were unsuitable habitat because the soils were not clayey sands: they were often sandy grits with small stones and rocks. These soils supported *Eucalyptus* woodland and open-forest with a shrub storey of *Acacia*, Epacridaceae, Myrtaceae and Proteaceae, eg the steep southern slope at the junction of the walking tracks to Valhalla and to Asgard Swamp with the Victoria Falls Road (between Bell and Mount Victoria).

Flowers: *Blandfordia cunninghamii* flower rarely except after fire. It would be unusual, in the absence of fire, for more than two per cent to flower in any one year, and often the flowering rate is lower than two per cent. At Mount Kembla, in a total of 900 mature *Blandfordia* plants, only two flowered in 2004. Of the 662 mature plants south of Cliff Drive in Leura, seven flowered in 2004. Flower stems are stout and often up to a metre high, although on exposed cliffs (as at Mount Kembla) they may be only 200 mm high. Occasionally plants have two or more stems. However, it may be that such multiple stems arise from more than one plant; their physical proximity precludes separate identification. Our observations are that the number of flowers per stem can be in the range 12-32. They hang in a dramatic and graceful cluster.

Fire: The importance of fire in the stimulation of flowering and seed set of *Blandfordia cunninghamii* is not clear. However, we note that in one occurrence of 50 plants, south of McMahons Point, burnt in early 2002 in a moderate burn, 15 plants flowered within a year. None has flowered since (2005).

Seeds: A typical seed head may have up to 32 capsules, which, unlike the flower bells, are held vertically upwards. Each capsule has three loculi which dehisce septicidally. Each loculus contains numerous, typically 10-15, hairy brown seeds. A seed head may contain several hundred seeds. Seed set appears to be consistently good, although pollination vectors are not known.

Germination and propagation: Fresh seeds germinate easily, and may be reared by conventional nursery practices, but plants are difficult to bring to flowering maturity. The SPBG propagated some *Blandfordia cunninghamii* seeds and introduced the seedlings into suitable habitat, but none reached maturity. The fate of seeds in natural circumstances is not known, but paucity of juvenile plants in the environment suggests, among other factors, high seed predation.

Generation length: *Blandfordia cunninghamii* generation length is not known, but the low rate of recruitment of adult plants suggests that generation length of *Blandfordia cunninghamii* is not years, but decades. A feature of our survey was the paucity of juvenile plants. Our criterion for a juvenile plant was one which had five leaves or less: differences in leaf length and leaf width were ascribed to slight differences in habitat. The proportion of juveniles in a given population was always less than one percent, and often zero, suggesting a long generation length.

Conservation assessment

International Union for Conservation of Nature (IUCN) rules for assessment of the conservation status of threatened species involve several parameters (IUCN 2001, 2004). For the geographic distribution criterion, estimates are required of Extent of Occurrence and Area of Occupancy. Extent of Occurrence (EOO) is the area of a minimum convex polygon encompassing all known, inferred or projected sites of present occurrence. The EOO for *Blandfordia cunninghamii* is a roughly triangular area of 2300 km^2 from the Blue Mountains in the northwest to the Illawarra in the southeast (Fig. 2). The occurrence of *Blandfordia cunninghamii* on Mount Kembla at Wollongong is separated by about 80 km from the Blue Mountains. Including the Wedderburn and Bargo River occurrences would increase it to about 3000 km^2.

Treating the upper Blue Mountains and Mt Kembla occurrences separately gives an EOO for the Blue Mountains (as shown by the heavy line around that area) of 936 km^2, and an EOO at Mount Kembla of 4 km^2, i.e. a total EOO of 940 km^2.

The IUCN Area of Occupancy (AOO) is the smallest area occupied within the EOO that is essential to the survival of existing populations of the species. Since our sampling plots covered every plant we could locate, our estimate of the AOO is a minimum of 3.4 ha. Additional sites likely to be found in the future would increase our measured AOO, but it is unlikely to increase it beyond 5 ha.

However, there is an IUCN (2001) caveat noting that 'the finer the scale at which the distributions or habitats of taxa

are mapped, the smaller the area will be that they are found to occupy, and the less likely it will be that range estimates (at least for AOO) exceed the thresholds specified in the criteria.' We converted our 10 x 10m sampling to the 2 x 2 km scale using IUCN Guidelines (2004), a process that increased the AOO from 3.4 ha to 80 km^2.

With an EOO of 940-2300 km^2 and an AOO of 80 km^2 *Blandfordia cunninghamii* meets the first part of the IUCN Geographic Range Rule B (either for B1or B2) requirement for a Vulnerable taxon. However to comply at least two of subrules a-c must also apply.

Compliance with subrule a requires severe fragmentation or existence at no more than 10 locations. IUCN defines *Locations* as geographically or ecologically distinct areas in which a single threatening event can rapidly affect all individuals of the taxon present. The size of a Location depends on the area covered by the threatening event and may include part of one or many Subpopulations.

We recorded 8 separate geographic locations (Table 1, Fig. 2) and regard the remaining populations in the upper Blue Mountains the Katoomba–Leura–Wentworth Falls occurrences as one location with 18 subpopulations as per IUCN (2001). For example a severe bushfire travelling north and east up the Jamison Valley could constitute a major threatening event, and would encompass several Subpopulations. The close proximity of the subpopulations may also make them vulnerable to disease. The related *Blandfordia punicea* in Tasmania is recognized as a susceptible species to the pathogen *Phytophthora cinnamomi* (Podger et al 1990), and it is likely that *Blandfordia cunninghamii* is similarly susceptible. The pathogen is likely to be spread in soil and water and the given proximity to urban development to most subpopulations along the Katoomba–Leura cliffline and the network of footpaths and roads between sites, the chance of spread is high. *Phytophthora cinnamomi* is listed as a Key Threatening Process under the NSW *Threatened Species Conservation Act*).

Compliance with subrule b requires continuing decline, observed, inferred or projected. Comparing our survey with the limited data from Porter (1992) indicates there is a continuing decline in quality of habitat and in number of mature individuals at some sites particularly in relation to increased track use. Ongoing threats include urban run-off, trampling and climate change. All are insidious, longterm, and difficult to control. Many *Blandfordia* occurrences, especially between Katoomba and Wentworth Falls, are on or near walking tracks, and often just below private property or public areas where pollution is the norm and declines in numbers observed in areas such as Leura Cascades and Katoomba Falls may have been caused by urban run-off and trampling. It seems unlikely however that declines in numbers at Perrys Lookdown, Govetts Leap or Wentworth Falls could be attributed to either trampling or pollution. Rainfall in the Blue Mountains in recent years has been low and climate change poses potential threats. In the five years since 2000, rainfall has been well below average over the geographic range of *Blandfordia cunninghamii*.

Illegal flower and seed collecting are also threatening events, but the hidden nature of many habitats, and their relative inaccessibility suggests that these events may not be crucial, in contrast with the same threats to other *Blandfordia* species.

Subrule c Extreme fluctuations is not met by this species as it appears to be a relatively long-lived plant with low turnover of plants and only intermittent periods of recruitment. No extreme fluctuations were noted.

We therefore consider that *Blandfordia cunninghamii* could meet IUCN requirements as a Vulnerable species.

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Fig. 5. Distinctive red and yellow flower of *Blandfordia cunninghamii*.

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