Conservation Assessment of *Callitris oblonga* subsp. *parva* K.D.Hill (Cupressaceae)

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***Callitris oblonga* subsp. *parva* K.D.Hill (Cupressaceae)**
Distribution: Endemic to NSW
Current EPBC Act Status: Listed at species level as Vulnerable. Subspecies not listed.
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Proposed listing on NSW BC Act and EPBC Act: Critically Endangered.

Reason for change: *Callitris oblonga* has been listed as Vulnerable under the BC Act and EPBC Act and the two subspecies that occur in NSW are now being assessed separately. There has also been a genuine change based on estimated and projected population reductions due to adverse fire regimes.

Summary of Conservation Assessment

Callitris oblonga subsp. *parva* was found to be eligible to be listed as Critically Endangered under Criterion A4ab.

The main reasons for this species being eligible are (i) *Callitris oblonga* subsp. *parva* has suffered an estimated reduction in the number of mature individuals of approximately 89% since 1990 and this reduction is projected to continue across a three-generation timeframe of 72 years (1990-2062); and (ii) this reduction has occurred due to adverse fire regimes, particularly increasing occurrences of severe wildfire.

Callitris oblonga subsp. *parva* near Ebor, northern NSW. Image: Gavin Phillips

Description and Taxonomy

Callitris oblonga subsp. *parva* (Pygmy Cypress Pine) is a conventionally accepted species (CHAH 2023) in family Cupressaceae. It is described as a small tree or shrub to 5 m tall. Branches dense, erect. Leaves *c.* 4 mm long on ultimate branchlets, dark green; dorsal surface prominently but not acutely keeled. Male cones solitary or in clusters of 2–5, ovoid, to 2 mm long. Female cones usually clustered, sessile or on short, thick fruiting branchlets, ovoid, 12–15 mm long, 10–14 mm diam., distinctly longer than broad, persistent and holding seeds for several years after maturity; cone scales 6 (rarely 8 on fruiting juvenile branches), thick, with a short, thickened dorsal point near or at the apex, separating almost to the base, incurved after opening; alternate scales reduced, about two-thirds as long as intervening scales; larger scales tapered; columella narrow, entire, 3-lobed, 1–3 mm high. Seeds numerous, dark brown; wings 2 or 3, *c.* 2 mm wide (Hill 1998).

Callitris oblonga subsp. *parva* is the northernmost of three geographically disjunct subspecies of *C. oblonga.* The nominate subspecies *C. oblonga* subsp. *oblonga* is endemic to Tasmania and is differentiated from subsp. *parva* by the much larger female cones 14–22 mm long (Hill 1998). *Callitris oblonga* subsp. *corangensis*, endemic to the Corang River in southern New South Wales (NSW), is then differentiated from subsp. *parva* by having the alternate scales on the female cones only about half the length of the intervening scales (Hill 1998). *Callitris oblonga* subsp. *parva* is also easily distinguishable from other *Callitris* species by its small stature and the distinctly ovoid female cones (OEH 2021; Hill 1998). However, it is not known to co-occur with any other *Callitris* species at known sites (Nadolny and Benson 1993).

Distribution and Abundance

Callitris oblonga subsp. *parva* is an uncommon taxon with a sporadic and highly localised distribution along the eastern fringe of the NSW Northern Tablelands (Hill 1998). It ranges from the Boonoo Boonoo River northeast of Tenterfield in the north to the Hastings River east of Walcha in the south (Nadolny and Benson 1993; Hunter 1999). This area lies within the New England Tableland Bioregion (DAWE 2012) and spans the traditional lands of the Anaiwan, Banbai, Biripi, Bundjalung, Jukambal, Gumbaynggir and Ngarabul First Nations people (Horton 1996; NSW NPWS 2002a, 2002b, 2005, 2007, 2009).

Callitris oblonga subsp. *parva* is restricted to riparian and swamp areas in several discrete and often isolated river and creek sections across the Northern Tablelands. It is currently known from the Boonoo Boonoo River, Basket Swamp Creek and Wellingtons Creek in the Boonoo Boonoo area northeast of Tenterfield, the Sara River and Backwater Creek near Backwater, Marengo Creek north of Ebor, Bullock Creek, Serpentine Creek and Sandy Creek in the Snowy Range southeast of Ebor and the upper Hastings River east of Walcha (Table 1). This scattered distribution is thought to indicate *C. oblonga* subsp. *parva* may be a relict taxon with a previously more widespread distribution (Nadolny and Benson 1993). *Callitris oblonga* subsp. *parva* is known to have diverged from the other subspecies of *C. oblonga* approximately 2.45–2.66 million years ago and genetic structuring has been found between sites of *C. oblonga* subsp. *parva* (Worth *et al.* 2018). It is thought that cycles of glaciation and aridification, the increasing dominance of flammable sclerophyll vegetation, and the contraction of fire sensitive vegetation through the Pleistocene may have driven this genetic isolation and shaped the current distribution (Harris 1989; Worth *et al.* 2018).

Table 1 - Population breakdown of *Callitris oblonga* subsp. *parva* from all known sites

Site	Subpopulation	Estimated Maximum Mature Individuals	Estimated Mature Individuals pre-2019	Estimated Mature Individuals 2021	Decline in Mature Individuals	References
Boonoo Boonoo River	Boonoo Boonoo	Unknown - Described as frequent/common at site	Unknown	Unknown	Unknown	ALA 2023; BioNet 2023
Basket Swamp Creek	Boonoo Boonoo	9,400	9,400	0	100%	Hunter 2020; Greenloaning Biostudies 2022
Wellingtons Creek	Boonoo Boonoo	608	541	158	74%	Hunter 2020; Greenloaning Biostudies 2022
Sara River	Backwater	458	416	11	98%	Hunter 2020; Greenloaning Biostudies 2022
Backwater Village	Backwater	100+	Unknown	50	50%	Nadolny and Benson 1993; G. Phillips pers. obs. November 2021
Kookabookra	Backwater	70+	Unknown	Unknown	Unknown	Nadolny and Benson 1993
Marengo Creek	Marengo Creek	1,300	816	791	39%	Nadolny and Benson 1993; Greeloaning Biostudies 2022
Bullock Creek	Snowy Range	850	850	1	99%	Hunter 2020; Greenloaning Biostudies 2022
Serpentine Creek	Snowy Range	1,500	1,150	0	100%	Nadolny and Benson 1993; Greenloaning Biostudies 2022
Sandy Creek	Snowy Range	7,136	7,136	1,487	79%	Hunter 2020; Greenloaning Biostudies 2022
Hastings River	Hastings River	1,500	253	19	99%	Brown 1990; Greenloaning Biostudies 2022
POPULATION TOTALS		**22,922**	**20,562**	**2,517**	**89%**	

The population of *Callitris oblonga* subsp. *parva* consists of five subpopulations as defined by the IUCN (IUCN 2022; Table 1). Conifers regularly exhibit long-distance gene flow through wind pollination, with some conifers having effective pollen dispersal of up 30 km (Bagnoli *et al.* 2011). Seed dispersal, most likely by wind, has also been suggested to explain high gene flow over several kilometres in *Callitris verrucosa* (Dunker 2015). Coupled with the ability for *C. oblonga* seeds to be transported downstream by water flow (Brown 1990; DCCEEW 2023), this means sites either united by river catchments or within overland distances of up to 10 km can be linked as subpopulations likely to be experiencing regular gene flow. Isolated stands distant by more than 30 km from the next nearest, such as those at Marengo Creek and the Hastings River are less likely to experience gene flow and are thus treated as distinct subpopulations.

The northernmost subpopulation of *Callitris oblonga* subsp. *parva* is in the Boonoo Boonoo district northeast of Tenterfield. There are three disjunct sites within the subpopulation, all of which are within the headwaters of the Clarence River catchment. The first, on the Boonoo Boonoo River, is of unknown size; although *C. oblonga* subsp. *parva* has been described as 'frequent' and 'common' on the site, it has only been recorded twice, in 1973 and 1993 (ALA 2023; BioNet 2023). This site appears to straddle a section of river that forms the boundary of Boonoo Boonoo National Park and private property, so may exist on both tenures. Approximately 7–8 km south is a large stand on Basket Swamp Creek within Boonoo State Forest. This site was estimated to have over 9,400 individuals prior to being burnt in February 2019 (Hunter 2020), with no live mature plants and only limited seedling recruitment since recorded (Hunter 2020; Greenloaning Biostudies 2022; A. Fawcett pers. comm. July 2023). Another stand is then 3–4 km south on Wellingtons Creek within Basket Swamp National Park. This stand was estimated to have 608 mature individuals prior to 2019 (Hunter 2020), with 158 mature plants remaining post-fire in 2021 (Greenloaning Biostudies 2022).

The closest subpopulation of *Callitris oblonga* subsp. *parva* to Boonoo Boonoo is approximately 120 km south around the village of Backwater. This subpopulation occupies approximately 26 km of the Sara River and the major tributary of Backwater Creek (Nadolny and Benson 1993). The occurrences along these extensive stretches of river and creek are sporadic, with large distances between recorded stands. Much of the area is private land historically cleared for agriculture and has never been fully surveyed (Nadolny and Benson 1993; Hunter 2020; G. Phillips pers. obs. November 2021; Greenloaning Biostudies 2022). A substantial portion of the subpopulation occurs around the confluence of the Sara River and Backwater Creek within Warra National Park, with approximately 458 plants within the reserve prior to 2019 (Hunter 2020). Following the Crown Mountain Fire of 2019, only 11 mature individuals remain at this site (Greenloaning Biostudies 2022). Upstream of the reserve on Backwater Creek at Backwater Village, two disjunct stands of *C. oblonga* subsp. *parva* have also been recorded in largely cleared pastoral lands (Nadolny and Benson 1993). One of these stands was still extant with at least 50 mature individuals in 2021 (G. Phillips pers. obs. November 2021). The other, which is estimated to be approximately the same size (Nadolny and Benson 1993), was within a heavily impacted area of the 2019 fire (G. Phillips pers. obs. November 2021), and so is considered to have suffered similar losses to the stands within Warra National Park. Finally, several records of *C. oblonga* subsp. *parva* form a site on the Sara River downstream of Warra National Park at the locality of Kookabookra (Nadolny and Benson 1993). Early surveys

indicate these stands possess at least 70 mature individuals; however, these sites, all on private land, have not been surveyed again since and are currently of unknown size.

Approximately 35 km to the east of the Backwater subpopulation is the isolated Marengo Creek subpopulation. This subpopulation consists of a single stand extending along approximately 2 km of stream, primarily within private lands used for grazing with some stands within Guy Fawkes River National Park (Nadolny and Benson 1993). This subpopulation is long unburnt (NSW NPWS 2022), however, it appears to have been reduced from an estimated 1,300 mature individuals in 1993 (Nadolny and Benson 1993) to approximately 791 mature individuals in 2022 (Greenloaning Biostudies 2022).

Approximately 35 km southeast of Marengo Creek, southwest of Ebor, is the Snowy Range subpopulation. This subpopulation spans three streams – Bullock Creek and Serpentine Creek, which join in the Styx River catchment, and Sandy Creek, which is approximately 10 km west of the other creeks and within the Oaky River catchment. The Bullock Creek site, which is within a road reserve and private lands, is confined to an 800 m stretch of stream and was estimated to have 850 mature individuals prior to 2019 (Nadolny and Benson 1993; Hunter 2020). Following the Guyra Rd Fire in 2019, this site has reduced to one mature individual (Greenloaning Biostudies 2022). Downstream of this site is the Serpentine Creek site, which extends from the confluence with Bullock Creek upstream through private land for approximately 3 km (Nadolny and Benson 1993). This site was estimated to have at least 1,500 mature individuals in 1993 (Nadolny and Benson 1993); however, following the 2019 fire, there are no mature individuals remaining (Greenloaning Biostudies 2022). The Sandy Creek site, which spans 6 km of stream (Nadolny and Benson 1993) was only partially burnt in 2019 with a pre-fire population estimated at 7,136 mature individuals (Hunter 2020). The largest stands at this site previously existed within Cathedral Rock National Park but were heavily affected by the 2019 fire, with limited recruitment since observed (Hunter 2020; Greenloaning Biostudies 2022; A. Fawcett pers. comm. July 2023). The remainder of this site is on private land and road reserve which did not burn in 2019, with recent surveys estimating the current number of mature individuals along Sandy Creek as 1,487 (Greenloaning Biostudies 2022).

The southernmost subpopulation is east of Walcha on the Hastings River within Werrikimbe National Park, approximately 76 km south of the Snowy Range subpopulation. This subpopulation is confined to a 3 km stretch of river, although it is once again patchily distributed along the stream (Brown 1990; Nadolny and Benson 1993; Hunter 2020). In 1990 following comprehensive surveys, the population was estimated as having 1,500 individuals (Brown 1990) before dropping to 253 individuals by 2019 (Hunter 2020). Following the Carrai Creek Fire of 2019, this number has dropped to 19 known mature individuals, although inaccessibility during recent surveys means some parts of the subpopulation may still harbour live plants (Hunter 2020; Greenloaning Biostudies 2022).

Considering all subpopulations of *Callitris oblonga* subsp. *parva*, the minimum estimated population size prior to 2019 is 22,922 mature individuals. Following recent post-fire surveys, this number has reduced to an estimated 2,517 mature individuals, representing an overall population reduction of 89%. While recruitment is now underway within burnt populations (A. Fawcett *in litt.* June 2023), recruitment is expected to be limited overall as there is evidence of extensive seedling losses at two

sites. Over 600 seedlings recorded at the Hastings River in 2020 (Hunter 2020) and over 200 seedlings recorded at Bullock Creek in February 2021 (Phillips and Cohen 2021) were subsequently not found again in May 2021 (Greenloaning Biostudies 2022), and this is in line with other recent survey findings for *C. oblonga* subsp. *corangensis* (G. Wright pers. comm. June 2023). This limited recruitment, as well as access limitations of surveys to date (Nadolny and Benson 1993; Hunter 2020; Greenloaning Biostudies 2022), means that the current estimate of 2,517 mature individuals is considered a conservative minimum population size for this assessment.

Area of Occupancy and Extent of Occurrence

The Area of Occupancy (AOO) of *Callitris oblonga* subsp. *parva* is estimated to be 96 km^2 using 2 x 2 km grid cells, the scale recommended by IUCN (2022). The Extent of Occurrence (EOO) is estimated to be 6,184 km^2 and is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2022). Both EOO and AOO were calculated using ArcGIS (Esri 2015), enclosing all confirmed survey records and cleaned spatial datasets. Based on these estimates, *C. oblonga* subsp. *parva* has a highly restricted AOO and a moderately restricted EOO.

Number of Locations

When the threat of adverse fire regimes, especially increased frequency and severity of wildfires, is considered, the five subpopulations of *Callitris oblonga* subsp. *parva* can be treated as five threat-defined locations, as per the IUCN definition (IUCN 2022). This is due to the increased frequency and severity of wildfires being the most serious plausible threat that results in the lowest number of locations for the taxon. The large distances between these locations are significant enough that each is considered a geographically distinct area where a single fire event is unlikely to extend to any other location based on the fire history of the region, although each subpopulation is considered at equal risk of decline induced by repeat fire given all were affected to some extent in the 2019/20 fire season (NSW NPWS 2022).

Cultural Significance

This assessment is not intended to be comprehensive of the traditional ecological knowledge that exists for *Callitris oblonga* subsp. *parva*, or to speak for Aboriginal people. Aboriginal people have a long history of biocultural knowledge, which comes from observing and being on Country, and evolves as it is tested, validated and passed through generations (Woodward et al. 2020). Aboriginal peoples have cared for Country for tens of thousands of years (Bowler et al. 2003; Clarkson et al. 2017). There is traditional ecological knowledge for all plants, animals and fungi connected within the kinship system (Woodward et al. 2020). Traditional ecological knowledge referenced in this assessment belongs to the relevant knowledge custodian and has been referenced in line with the principals of the NSW Indigenous Cultural and Intellectual Property protocol (ICIP) (Janke and Company 2023).

Callitris species have long been used by Aboriginal people, with the wood used for firewood, the branches for spears, woomeras, ceremonial objects, paddles, canoe poles, music sticks and fish spears, the bark for rope and as insect repellent, and the resin for glue to make weapons (DAFF 2008; ANBG 2012). Additionally, the cones,

bark leaves and ash are components in various medicines (DAFF 2008). Given some sites of *C. oblonga* subsp. *parva* are adjacent to areas of ceremonial importance and/or meeting places for neighbouring tribes (NSW NPWS 2002b, 2005), it is likely that the subspecies was used by Aboriginal people for some of these purposes.

Ecology

Habitat

Callitris oblonga subsp. *parva* is typically found along montane rivers and streams in shrublands open woodlands and riparian heaths, although it can occupy drier sites on exposed ridges near to river bends, often some distance from the stream channel itself (Nadolny and Benson 1993; Hunter 1999; Greenloaning Biostudies 2022). Quite often it is found at bends, pools or confluences in streams where the banks are gently sloping, and seed is more easily deposited with lower flow rates (Brown 1990). *Callitris oblonga* subsp. *parva* usually grows on alluvial, sandy soils on granite and metamorphic geologies, and can also grow in crevices on bare rock although it is often stunted in these cases (Brown 1990; Nadolny and Benson 1993). It appears to favour wetter, cool areas with average minimum winter temperatures approaching zero and an average annual rainfall 800–1,200 mm (Nadolny and Benson 1993).

Callitris oblonga subsp. *parva* can grow in dense, monocultural thickets with little to no understorey, especially in more open spots, and mass seedling recruitment following disturbances can result in stands of uniform age (Brown 1990; Nadolny and Benson 1993; Hunter 2020). Species that commonly co-occur with *C. oblonga* subsp. *parva* include *Eucalyptus nova-anglica, E. pauciflora, E. acaciiformis, Allocasuarina littoralis, Bursaria spinosa, Gleichenia dicarpa, Leptospermum polygalifolium, Epacris microphylla, Hakea microcarpa, Acacia rubida*, and *Lomandra longifolia* (Nadolny and Benson 1993 Phillips and Cohen 2021).

The Plant Community Types (PCT) that *Callitris oblonga* subsp. *parva* has been recorded in include Eastern New England Granite Wet Heath (PCT 3934), Western New England Felsic Rock Shrubland (PCT 3828), Armidale Creekflat Snow Gum Woodland-Scrub (PCT 3351), Eastern New England Leucogranite Mallee Scrub (PCT 3827) and Eastern New England Ranges Blackbutt Forest (PCT 3501) (Hunter 1999, 2004, 2005; G. Phillips pers. obs. November 2021; Phillips and Cohen 2021; DPE 2022a, 2022b). However, *C. oblonga* subsp. *parva* may not be confined to these PCTs and may be found within other PCTs that occur in the area.

Life History, Growth and Generation Length

Callitris oblonga subsp. *parva* is an obligate seeding species, with fire and floods causing documented plant mortality, and it is not known to reproduce vegetatively (Nadolny and Benson 1993; OEH 2021). Damage through grazing stimulates coppicing from the base (Nadolny and Benson 1993), and this may mean that large plants are able to survive lighter disturbances, with plant age and stem size determining the chance of survival.

The species does not retain a soil seedbank. Seed is held in cones in the canopy for long periods and are released once the limb holding the cones dies, typically following a major disturbance such as fire or flood (Nadolny and Benson 1993). The reduction of competition for the seedlings following fire or flood then allows mass recruitment, commonly resulting in thick, even-aged stands (Brown 1990; Hunter 2020).

Callitris oblonga subsp. *parva* is moderately fast growing, with plants being reproductively mature at 1 m tall and two years of age (W. Sheather pers. comm. in Nadolny and Benson 1993). In the juvenile phase, *C. oblonga* has very spiky leaves, likely to deter herbivores (Harris 1989). Studies have shown trees in the Sandy Creek site to be approximately 10–12 years of age at heights of 2–4 m and 20 years of age at 6 m, with tagged plants growing an average of 0.36 m per year (Nadolny and Benson 1993). The lifespan of *C. oblonga* subsp. *parva* is likely typically dictated by disturbance events; however, the maximum lifespan is considered similar to *C. oblonga* subsp. *oblonga*, which is estimated at approximately 70 years (Harris 1989).

Given *Callitris oblonga* subsp. *parva* does not retain a soil seedbank and has limited seedling recruitment outside of disturbance cycles, generation length can be estimated using the age of first reproduction + *z* * length of reproductive period (IUCN 2022), where *z* is a constant between 0 and 1 calculated using survivorship and the relationship between fecundity and age. Using a maximum lifespan of 70 years, a primary juvenile period of two years and a value for *z* of 0.33 as calculated for other conifer species (Fung and Waples 2017), the generation length of *C. oblonga* subsp. *parva* is estimated at approximately 24 years.

Reproductive and Seed Ecology

Pollination in all *Callitris* is wind facilitated, with many conifers able to transfer pollen over distances of up to 30 km by producing a 'pollen rain' during peak spore release (Bagnoli *et al.* 2011). The species is monoecious, having male and female flowers and fruits (cones) on the same plant. Male cones of *Callitris oblonga*, borne on the ends of smaller branches, can be in any stage of development throughout the year, meaning pollen is likely available year-round (Harris 1989). However, peak pollen release has been observed in autumn in *Callitris oblonga* subsp. *oblonga* (Harris 1989) and timing is likely similar in subsp. *parva.* Female cones become receptive to pollen from January, and once pollinated, mature over a period of 12 months (Harris 1989). Trees usually contain large numbers of clustered female cones, often only around the largest branches (Nadolny and Benson 1993; G. Phillips. pers. obs. August 2018, November 2021). Only fully mature cones hold seed that is mature enough to be able to germinate (Brown 1990; Nadolny and Benson 1993).

Seed dispersal in *Callitris oblonga* subsp. *parva* is considered to predominantly be via water, either by downstream flows or floods (Brown 1990; DCCEEW 2023). However, the existence of stands away from the stream edge where water is unlikely to have moved seeds means other seed dispersal agents are also likely (Hunter 2020). Wind has been noted to potentially disperse seeds up to 8 km and regularly within 40–50 m distances in *Callitris verrucosa* (Dunker 2015) and the winged seeds of *C. oblonga* subsp. *parva* (Hill 1998) likely allow similar wind dispersal. Birds have also been postulated to facilitate dispersal in *Callitris* (Nadolny and Benson 1993; Dunker 2015), though no evidence supports this in *C. oblonga* (Harris 1989), and birds are more likely to be a seed predator given evidence of large amounts of cones consumed by cockatoos in stands of *C. oblonga* subsp. *parva* (Greenloaning Biostudies 2022).

Callitris oblonga subsp. *parva* has no known seed dormancies (Offord *et al.* 2004). There has been found to be an average of 33 seeds per cone in the Hastings River subpopulation (Brown 1990) and germination rates for viable seeds are variable, with 61% germination recorded from the Hastings River (Brown 1990), 94–100% from

Bullock Creek, 48–64% from Sandy Creek and 64-98% from Backwater Village (RBGDT 2023). However, overall seed viability is typically very low, with only an average of 8% of seeds in a crop being viable (Brown 1990) and most cones contain large amounts of either unfilled, rotted or immature seeds (Brown 1990; G. Phillips pers. obs. August 2018, November 2021).

Threats

The primary threat to *Callitris oblonga* subsp. *parva* is adverse fire regimes, in particular increased frequency and severity of wildfires. This can eliminate or rapidly reduce the size of stands and has been the main driver of population reductions across the population to date (Nadolny and Benson 1993; Hunter 2020; Greenloaning Biostudies 2022). Additional identified threats include flooding, grazing by domestic stock, clearing for agriculture and infrastructure, competition from weeds, and damage from feral pigs (Nadolny and Benson 1993; Hunter 2020; Phillips and Cohen 2021; Greenloaning Biostudies 2022).

Adverse Fire Regimes and interactions with drought

Adverse fire regimes (increasing fire frequency and severity) are estimated to have caused a very large reduction in the population size of *Callitris oblonga* subsp. *parva* and are contributing to continuing decline in the number of mature individuals and the extent and quality of habitat. Prior to 1990, very few sites of *C. oblonga* subsp. *parva* had any recorded incidences of fire (NSW NPWS 2022), and the contemporary distribution is thought to be derived from persistence in fire refugia (Harris 1989; Nadolny and Benson 1993). However, severe fires are now becoming more frequent in the habitat of *C. oblonga* subsp. *parva* and have overcome the natural barriers that previously appear to have prevented fires from burning fully into stands. These changes in the fire regime also produce inhospitable conditions for seedling establishment.

Historically, dense groves of *Callitris oblonga* have been observed as retarding fire, with fires only penetrating the edge of thickets and the centrally located plants remaining unburnt (Harris 1989; Nadolny and Benson 1993). This results from a lack of fuel within monocultural *Callitris* thickets, with grassy understoreys unable to develop and exclusion of fire-carrying sclerophyll taxa such as eucalypts (Clayton-Greene 1981; Harris 1989; Nadolny and Benson 1993). However, recent fires have resulted in complete destruction of dense stands of *C. oblonga* subsp. *parva* in several different subpopulations (Hunter 2020; Greenloaning Biostudies 2022). Complete stand death then allows the establishment of faster-growing sclerophyll taxa within the *Callitris* thickets which can compete with *Callitris* seedlings, resulting in an overall decline in mature individuals, lowered fecundity of mature individuals, and a reduction in habitat extent and quality by making it more fire prone into the future (Harris 1989; Nadolny and Benson 1993; Greenloaning Biostudies 2022).

Following major fires in 2019 across the range of the taxon, abundances in individual sites where fires have occurred have dropped by between 84 and 99%, with the overall population reduction due to fire since 1990 now estimated to be approximately 89% (Hunter 2020; Greenloaning Biostudies 2022). Although limited recruitment is underway in some stands (A. Fawcett *in litt.* June 2023, pers. comm. July 2023), recruitment failure is apparent in some subpopulations and declines in surviving plants

are continuing year on year (Hunter 2020; Greenloaning Biostudies 2022). Therefore, pre-fire stand numbers are unlikely to be replenished for a significant amount of time, if at all. As seed is stored in the canopy of the subspecies and no persistent soil seedbank exists, the sole source of seed is from mature individuals that bear cones. Their continuing decline directly affects recruitment. Continuing decline due to adverse fire regimes also appears to be a longer-term trend in the population of *Callitris oblonga* subsp. *parva*. The Wellingtons Creek, Sara River, Marengo Creek, Serpentine Creek and Hastings River sites have been observed as already having reduced in number from recorded maximum abundances prior to 2019 (Table 1; Hunter 2020; Greenloaning Biostudies 2022). Of note is the Marengo Creek site, which had reduced from 1,300 to 816 between surveys in the early 1990s until immediately prior to the 2019 fires (Nadolny and Benson 1993; Hunter 2020). Similarly, the Hastings River site reduced from 1,500 mature individuals in 1990 (Brown 1990), to 420 individuals in 2013, then to 253 individuals immediately before 2019 (Hunter 2020). These declines are believed to have been caused by previous fires, with the fire history of the sites supporting this (Table 2; NSW NPWS 2022). At the most surveyed site at the Hastings River, the estimated loss of 83% from 1990 to 2019 includes a single wildfire in 1994 followed by a 25-year recovery period, indicating that severe fire can be highly detrimental to stands and recovery to pre-fire abundances requires extremely long timeframes if it is at all possible.

Table 2 - Wildfire history 1990-2022 for all known sites of *Callitris oblonga* subsp. *parva* (NSW NPWS 2022).

Site	Subpopulation	Fire	Year
Boonoo Boonoo River	Boonoo Boonoo		1993
			1997
		Wallangara	2019
Basket Swamp Creek	Boonoo Boonoo	Bald Rock	2002
		Wallangara	2019
Wellingtons Creek	Boonoo Boonoo	Boonoo	1994
		Bald Rock	2002
		Wallangara	2019
Sara River	Backwater	Crown Mountain	2019
Backwater Village	Backwater	Crown Mountain	2019
Kookabookra	Backwater		
Marengo Creek	Marengo Creek		1994
		Bees Nest	2019
Bullock Creek	Snowy Range	Ponds Creek	2004
		Guyra Rd	2019

Serpentine Creek	Snowy Range	Guyra Rd	2019
Sandy Creek	Snowy Range	Guyra Rd	2020
Hastings River	Hastings River		1994
		Carrai Creek	2020

This apparent increase in the destruction of *Callitris oblonga* subsp. *parva* stands by fire is also highly likely due to the interaction of fire with drought. Extreme drought was apparent across the New England Tableland in 2017–2019 (Bureau of Meteorology 2023), with stands of *C. oblonga* subsp. *parva* appearing in poor health and with much dead and dying foliage (G. Phillips pers. obs. August 2018). The Sara River stand was also noted as having suffered up to 16% mortality during this time (Hunter 2020). Drought conditions make *C. oblonga* subsp. *parva* stands more likely to carry fire by drying out the taxon's preferred habitat and increasing fuel loads.

The New England Tableland is predicted to become hotter, have fewer colder nights under 2°C annually, more hot days over 35°C annually and an increase in average and severe fire weather by 2079 (CSIRO and BOM 2022; AdaptNSW 2023). Additionally, fire weather is predicted to become harsher, and the time spent in drought is projected to increase on the East Coast through the 21st century (CSIRO 2023). Therefore, it is highly plausible that more frequent severe fires driven by these changes in climate will impact the *Callitris oblonga* subsp. *parva* population in the future, meaning estimated declines in mature individuals and habitat are strongly inferred to continue, especially if the currently recommended fire-free threshold of greater than seven years is exceeded (Appleby and Wright 2021). 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'Anthropogenic Climate Change' are listed as Key Threatening Processes under the *NSW Biodiversity Conservation Act 2016.* 'Fire regimes that cause biodiversity decline' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Flooding

Flooding, particularly following fire, is contributing to continuing decline in the number of mature individuals and quality of habitat of *Callitris oblonga* subsp. *parva.* While flooding is a natural process in the riparian habitat of *C. oblonga* subsp. *parva* and may help to disperse seeds, extremely high flows, particularly after fires, can uproot and destroy plants. This has been observed in the Sara River site following flooding in 2021, which resulted in a number of plants recorded in 2020 being completely destroyed and unable to be located the following year (Greenloaning Biostudies 2022). Erosion resulting from flooding immediately following fires has also been noted to adversely affect recruitment by removing seeds and seedlings resulting from post-fire seed release in *C. oblonga* subsp. *corangensis* (Appleby and Wright 2021). This has likely also occurred in subpopulations of *C. oblonga* subsp. *parva* such as at the Sara River. Intense rain and flooding in the Hastings River in March 2021 (Dakin 2021) may also explain the large loss of seedlings between the 2020 and 2021 surveys, where several hundred seedlings initially noted post-fire were subsequently unable to be located (Hunter 2020; Greenloaning Biostudies 2022). This means that flooding is contributing to continuing decline in the overall abundance and number of mature

individuals of *C. oblonga* subsp. *parva* by suppressing the germination required to re-establish stands post-fire.

Flooding in the Sara River in 2021 also saw plants uprooted and pushed over, which were then observed to collect large build-ups of flood debris (Greenloaning Biostudies 2022). Such build-ups of flood debris are considered to accentuate fire risk in *Callitris oblonga* stands, and these build-ups are more commonly observed in areas downstream of cleared agricultural lands (Harris 1989). This means that flooding contributes to continuing decline in the habitat quality of *C. oblonga* subsp. *parva* by making the habitat more fire prone in the long-term by disrupting thicket growth and depositing fuels into the stands.

Grazing by Domestic Stock

Domestic stock grazing has been observed to adversely affect the growth of *Callitris oblonga* subsp. *parva,* particularly in the Basket Swamp Creek, Sandy Creek, and Marengo Creek stands (Hunter 2020; Greenloaning Biostudies 2022). Cattle chew smaller mature plants resulting in a stunted growth habit, though this does not appear to prevent regeneration through the production of coppice growth (Nadolny and Benson 1993). Additionally, stunted plants as small as 20 cm in height are still able to bear cones (Nadolny and Benson 1993; Hunter 2020). Areas grazed by sheep are noted to be devoid of *C. oblonga* subsp. *parva*, indicating they may more heavily supress regeneration; however, goats do not appear to affect regeneration in the same manner (Nadolny and Benson 1993).

Domestic stock may reduce fecundity in *Callitris oblonga* subsp. *parva* by limiting reproductive output of the mature plants through their stunting of growth, and they may trample seedlings following recruitment events (Hunter 2020). Currently, the largest concentration of extant mature individuals (approximately 59% of the total population) is on private property at Sandy Creek, and the plants here have recently been noted to be heavily affected by stock grazing (Hunter 2020). This means that stock grazing is currently contributing to continuing decline in the number of mature individuals of *C. oblonga* subsp. *parva*.

Clearing for Agriculture and Infrastructure

Clearing for agricultural development has almost certainly caused a reduction in the population of *Callitris oblonga* subsp. *parva* in the past. While a number of sites remain within undisturbed vegetation and are largely protected, stands such as those at Sandy Creek and the Sara River have large gaps in otherwise continuous stands as result of past agricultural development (Nadolny and Benson 1993). Where clearing stops at the streambank and intact vegetation remains in these stands, it was noted that *C. oblonga* subsp. *parva* can persist, pointing to the clearing being the main driver of the discontinuity now seen in the stands (Nadolny and Benson 1993).

Callitris oblonga subsp. *parva* has been seen to colonise previously cleared grazing land at Sandy Creek, Marengo Creek, the Sara River, and Serpentine Creek (Nadolny and Benson 1993; Hunter 2020). However, this ability to recolonise cleared land appears to be contingent on the intensity of the land use. At Backwater Village, trees are largely confined to a small section of road reserve and are absent from all adjacent habitat in heavily cleared pastoral land (G. Phillips pers. obs. November 2021). This site is much more intensely grazed and managed than sites at Sandy Creek and Sara River (G. Phillips pers. obs. November 2021). This indicates that while such agricultural land use continues, continuing decline in the extent and quality of habitat

for *C. oblonga* subsp. *parva* in these areas is occurring. 'Clearing of native vegetation' is listed as a Key Threatening Process under the *NSW Biodiversity Conservation Act 2016.* 'Land clearance' is listed as a Key Threatening Process under the EPBC Act.

Clearing for infrastructure has also contributed to past population reductions, albeit in a more localised fashion. The Hastings River site is crossed by a management track and the Bullock Creek, Backwater Village, and Kookabookra sites are all immediately adjacent to roads, and in some cases, plants grow within road verges that are occasionally cleared during maintenance activities (G. Phillips pers. obs. November 2021). Plants at Bullock Creek, which straddle a major regional road, have been seen to be recruiting into areas disturbed by road maintenance activities (Hunter 2020) and healthy juveniles have been noted in the road shoulder at Backwater Village following seasons of heavy rain (G. Phillips pers. obs. November 2021). Some habitat was cleared during fire mitigation work adjacent to the management trail at the Hastings River site in 2019, resulting in the loss of at least one mature individual (Hunter 2020). This means that while road construction has almost certainly resulted in a loss of plants and potential habitat in the past, current decline due to this threat is likely trivial in magnitude and is not presently contributing to continuing decline.

Competition from Weeds

Weed competition, particularly from Blackberry (*Rubus anglocandicans*), has the potential to hinder the germination and growth of *Callitris oblonga* subsp. *parva* (Greenloaning Biostudies 2022). Blackberry can form dense thickets that exclude native species (DPE 2023a), and *C. oblonga* subsp. *parva* has been noted as being of much weaker form and less fecund when surrounded by such a dense shrub layer and it requires open ground to germinate (Brown 1990; Nadolny and Benson 1993; Greenloaning Biostudies 2022). Blackberry has been noted as previously occurring in all known stands of *C. oblonga* subsp. *parva* with the exception of the Hastings River (Nadolny and Benson 1993). However, recent surveys only observed Blackberry forming dense mats along the banks of Sandy Creek following the 2019 fires (Hunter 2020; Greenloaning Biostudies 2022). Given Sandy Creek now contains the largest remaining number of mature individuals (approximately 59% of the total population) after the 2019 fires, it can be reasonably inferred that Blackberry is contributing to continuing decline in the quality of habitat of *C. oblonga* subsp. *parva* by limiting recruitment on the riverbank and stunting the growth of any maturing trees.

Damage by Feral Pigs

Feral pigs (*Sus scrofa*) have been noted to cause damage to the habitat of *Callitris oblonga* subsp. *parva* at the Basket Swamp Creek, Hastings River, and Marengo Creek sites (Hunter 2020; Greenloaning Biostudies 2022). Pigs damage *C. oblonga* subsp. *parva* habitat through rooting up soils and leaf litter while searching for food and can foul watercourses through wallowing (Nadolny and Benson 1993; DPI 2023). Pigs have been considered a minor threat at times when *C. oblonga* subsp. *parva* stands are intact and plants are in high abundances (Nadolny and Benson 1993), though notable pig digging has been observed in recent surveys and is possibly affecting recruitment of seedlings post-fire (Greenloaning Biostudies 2022). Thus, while pigs are a plausible threat to the habitat of *C. oblonga* subsp. *parva*, their contribution to continuing decline is currently uncertain in magnitude. 'Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758' is listed as a Key Threatening Process under the *NSW Biodiversity*

Conservation Act 2016. 'Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs' is listed as a Key Threatening Process under the EPBC Act.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Callitris oblonga* subsp. *parva* has been adequate and there is sufficient scientific evidence to support the listing outcome.

Criterion A *Population size reduction*

Assessment Outcome: Critically Endangered under Criterion A4ab

Justification: *Callitris oblonga* subsp. *parva* has suffered an estimated population reduction of 89% since the monitoring of any stands began in 1990 due to adverse fire regimes, particularly increasing occurrences of severe wildfire. *Callitris oblonga* subsp. *parva* is a relict species, occupying wet habitat along watercourses that provide refugia from fire (Nadolny and Benson 1993). However, since 1990, several fires have burnt through stands of *C. oblonga* subsp. *parva* (NSW NPWS 2022) and this has resulted in a decline in abundance and habitat extent and quality across all sites. Following major fires since 2019, abundances in sites where fires have occurred have decreased by 84–99%, with the overall population reduction due to fire since 1990 now estimated to be approximately 89% (Hunter 2020; Greenloaning Biostudies 2022). Although limited recruitment is underway in some stands (A. Fawcett *in litt.* June 2023, pers. comm. July 2023), recruitment failure is apparent in some subpopulations and declines in surviving plants are continuing year on year due to the overall poor health of plants and the additional effects of flooding, grazing of domestic stock, clearing for agriculture and competition from weeds (Hunter 2020; Dakin 2021; G. Phillips pers. obs. November 2021; Greenloaning Biostudies 2022). As regeneration has not been observed in more intensely managed agricultural areas (G. Phillips pers. obs. November 2021) and severe fires are becoming more frequent in the habitat of *C. oblonga* subsp. *parva*, the estimated population reductions are considered to be irreversible and have not ceased. At Hastings River, the rate of decline between 1990-2019 was 83%. This subpopulation has been regularly surveyed in this timeframe, documenting the effects of a single intense fire that burnt the population in 1994 and the subsequent 25 years of recovery. The decline of 99% following the 2020 fire at this site can be considered a genuine reduction in the number of mature individuals rather than a demographic fluctuation. A low recruitment rate of similar proportion to 1994-2019 is expected to follow, and estimated reductions at other sites can also be considered genuine in the same manner. Given the New England Tableland region in which *C. oblonga* subsp. *parva* occurs is predicted to become hotter, have fewer colder nights under 2°C annually, more hot days over 35°C annually, and an increase in average and severe fire weather by 2079 (CSIRO and BOM 2022; AdaptNSW 2023), it is highly plausible that more frequent severe fires driven by these changes in climate will impact the *C. oblonga* subsp. *parva* population in the future and exacerbate already estimated declines in the abundance of the taxon. Therefore, *C. oblonga* subsp. *parva* is estimated to have undergone a very large, irreversible reduction of 89% in the number of mature individuals since the earliest surveys in 1990, and this is projected to continue across a window spanning three generations (72 years) to 2062, meeting the threshold for Critically Endangered.

Criterion B *Geographic range*

Assessment Outcome: Endangered under Criterion B2ab(i,ii,iii,v)c(iv).

Justification: *Callitris oblonga* subsp. *parva* is endemic to the New England Tableland in northern NSW and has a disjunct and highly restricted geographic distribution. The Extent of Occurrence (EOO) of *C. oblonga* subsp. *parva* has been calculated as 6,184 km^2, which meets the threshold for listing as Vulnerable. The Area of Occupancy (AOO) has been calculated as 96 km^2, meeting the threshold for Endangered.

In addition to these thresholds, at least two of three other conditions must be met to qualify for listing under Criterion B. These conditions are:

a) The population or habitat is observed or inferred to be severely fragmented or there is 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

   Assessment Outcome: Met for Endangered due to having five threat-defined locations.

   Justification: *Callitris oblonga* subsp. *parva* is found at five threat-defined locations when considering the most serious plausible threat of adverse fire regimes, particularly increased frequency and severity of wildfires.

   Callitris oblonga subsp. *parva* is not considered severely fragmented as all individuals are found in relatively large, non-isolated subpopulations.

b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals

   Assessment Outcome: Met for continuing decline projected for (i) extent of occurrence, (ii) area of occupancy, (iii) area, extent and quality of habitat, and (v) number of mature individuals.

   Justification: Continuing decline has been estimated and is inferred in the extent of occurrence, area of occupancy, area, extent and quality of habitat, and the number of mature individuals of *Callitris oblonga* subsp. *parva*. This is due to the effects of adverse fire regimes, flooding, grazing by domestic stock, clearing for agriculture and competition from weeds. *Callitris oblonga* subsp. *parva* is a relict species, occupying wet habitat along watercourses that provide refugia from fire (Nadolny and Benson 1993). However, since 1990, several separate severe fires have burnt through stands of *C. oblonga* subsp. *parva* (NSW NPWS 2022) resulting in estimated continuing declines in the number of mature individuals across all sites. Following major fires since 2019, abundances at sites where fires have occurred have decreased by 84–99%, with the overall population reduction due to fire since 1990 now estimated to be approximately 89% (Hunter 2020; Greenloaning Biostudies 2022). Although limited recruitment is underway in some stands (A. Fawcett *in litt.* June 2023, pers. comm. July 2023), recruitment failure is apparent in some subpopulations and declines in surviving plants are continuing year on year due to continued ill health of plants and death of seedlings due to flooding, grazing of domestic stock, clearing for agriculture and competition from weeds (Hunter 2020; Dakin 2021; G. Phillips pers. obs. November 2021;

Greenloaning Biostudies 2022). Additionally, drought and flood debris can diminish habitat quality by either drying out habitat or depositing ground fuels in the *C. oblonga* subsp. *parva* stands, increasing their susceptibility to further fire events. Given the New England Tableland region in which *C. oblonga* subsp. *parva* occurs is predicted to become hotter, have fewer colder nights under 2°C annually, more hot days over 35°C annually, and an increase in average and severe fire weather by 2079 (CSIRO and BOM 2022; AdaptNSW 2023), it is highly plausible that more frequent severe fires driven by these changes in climate will impact the *C. oblonga* subsp. *parva* population in the future and exacerbate already estimated declines in the distribution, habitat and abundance of the taxon. Furthermore, observed grazing by domestic stock and Blackberry infestations in the largest remaining stands at Sandy Creek (Hunter 2020; Greenloaning Biostudies 2022) are inferred to be contributing to continuing decline in the quality of habitat and number of mature individuals by stunting the growth of remaining mature plants, which in turn reduces fecundity (Brown 1990; Nadolny and Benson 1993; Greenloaning Biostudies 2022). Thus, continuing decline is estimated and is strongly inferred to continue in the extent of occurrence, area of occupancy, area, extent and quality of habitat, and the number of mature individuals of *C. oblonga* subsp. *parva.*

c) Extreme fluctuations.

Assessment Outcome: Met for fluctuation of (iv) number of mature individuals.

Justification: *Callitris oblonga* subsp. *parva* is a serotinous obligate seeding taxon which is killed outright by fire and maintains a canopy-stored seedbank (Nadolny and Benson 1993). As this canopy-stored seedbank is exhaustible following a single fire event, recently estimated declines in the number of mature individuals represent a decline in the overall total number of individuals. Therefore, *C. oblonga* subsp. *parva* is prone to undergo extreme fluctuations. Following the 2019/2020 fires, several subpopulations of *C. oblonga* subsp. *parva* were completely destroyed, with stands of up to 9,400 individuals suffering complete mortality (Hunter 2020). This means that *C. oblonga* subsp. *parva* experiences population fluctuations of greater than one order of magnitude, meeting the definition for extreme fluctuations (IUCN 2022).

Criterion C Small population size and decline

Assessment Outcome: Vulnerable under Criterion C1+2b.

Justification: The current estimated population for *Callitris oblonga* subsp. *parva* is a minimum of 2,517 mature individuals, meeting the threshold for Vulnerable.

At least one of two additional conditions must be met. These are:

C1. An observed, estimated or projected continuing decline of at least: 25% in 3 years or 1 generation (whichever is longer) (CR); 20% in 5 years or 2 generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Met for Critically Endangered.

Justification: Prior to the 2019/20 fires, the estimated population of mature individuals of *Callitris oblonga* subsp. *parva* was 20,562 (Hunter 2020; Greenloaning Biostudies 2022). Following the fires, the population had reduced to 2,517 (Hunter 2020; Greenloaning Biostudies 2022), representing a decline of 88% within one generation (24 years).

C2. An observed, estimated, projected or inferred continuing decline in number of mature individuals.

Assessment Outcome: Met.

Justification: Continuing decline has been estimated and is inferred in the number of mature individuals of *Callitris oblonga* subsp. *parva* due to the effects of adverse fire regimes, flooding, grazing by domestic stock, clearing for agriculture and competition from weeds.

However, at least 1 of the following 3 conditions also must be met:

a (i). Number of mature individuals in each subpopulation ≤50 (CR); ≤250 (EN) or ≤1000 (VU).

Assessment Outcome: Not met.

Justification: The largest subpopulation of *Callitris oblonga* subsp. *parva*, Snowy Range, contains a current minimum of 1,488 plants, exceeding the thresholds for this criterion.

a (ii). % of mature individuals in one subpopulation is 90-100% (CR); 95-100% (EN) or 100% (VU)

Assessment Outcome: Not met.

Justification: Current knowledge suggests the largest subpopulation of *Callitris oblonga* subsp. *parva* is the Snowy Range subpopulation, which contains an estimated 59% of the total population, exceeding the thresholds for this criterion.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Met.

Justification: *Callitris oblonga* subsp. *parva* is a serotinous obligate seeding taxon which is killed outright by fire and maintains a canopy-stored seedbank (Nadolny and Benson 1993). As this canopy-stored seedbank is exhaustible following a single fire event, recently estimated declines in the number of mature individuals represent a decline in the overall total number of individuals. Therefore, *C. oblonga* subsp. *parva* is prone to undergo extreme fluctuations. Following the 2019/2020 fires, several subpopulations of *C. oblonga* subsp. *parva* were completely destroyed, with stands of up to 9,400 individuals suffering complete mortality (Hunter 2020). This means that *C. oblonga* subsp. *parva* experiences population fluctuations of greater than one order of magnitude, meeting the definition for extreme fluctuations (IUCN 2022).

Criterion D Very small or restricted population

Assessment Outcome: Vulnerable under Criterion D2.

Justification: *Callitris oblonga* subsp. *parva* is currently estimated to have a minimum population of at least 2,517 mature individuals. However, the species only occurs at five threat-defined locations, rendering it prone to the effects of human activities and stochastic events such as increased severe fire events, which are rapidly driving the species to extinction in a very short time period.

To be listed as Vulnerable under D, a species must meet at least one of the two following conditions:

D1. Population size estimated to number fewer than 1,000 mature individuals

Assessment Outcome: Not met

Justification: *Callitris oblonga* subsp. *parva* is currently estimated to have a minimum population of at least 2,517 mature individuals.

D2. Restricted area of occupancy (typically <20 km^2) or number of locations (typically <5) with a plausible future threat that could drive the taxon to CR or EX in a very short time.

Assessment Outcome: Vulnerable under Criterion D2.

Justification: *Callitris oblonga* subsp. *parva* occurs at five threat-defined locations and has an estimated AOO of 96 km^2. Additionally, repeated episodes of severe fire have reduced the population by 88% within one generation, rapidly driving the species to extinction in a very short time period.

Criterion E Quantitative Analysis

Assessment Outcome: Data deficient.

Justification: Currently there is not enough data to undertake a quantitative analysis to determine the extinction probability of *Callitris oblonga* subsp. *parva.*

Conservation and Management Actions

Callitris oblonga subsp. *parva* is currently protected under the NSW *Biodiversity Conservation Act 2016* through the species-level listing of *C. oblonga* and a conservation project has been developed by the NSW Department of Planning and Environment under the Saving our Species program. The conservation project identifies priority locations, critical threats and required management actions to ensure the species is extant in the wild in 100 years. *Callitris oblonga* sits within the site-managed management stream of the SoS program.

Activities to assist this species currently recommended by the SoS program (OEH 2021; DPE 2023b) include:

Habitat loss, disturbance and modification

- Protect known stands from too frequent fire and ensure fire prescriptions such as minimal return intervals are described for stands.
- Protect known stands and habitat areas from grazing stock.

- Identify and protect stands and areas of habitat along roadsides and illegal tracks.
- Control weeds, particularly blackberry, in habitat areas.
- Protect areas of known and potential habitat from clearing, fragmentation or disturbance.
- Implement integrated pest control across sites as required, particularly targeting feral pigs.
- Expand and reconnect isolated remnants of habitat.

Survey and monitoring

- Monitor species recruitment and adult condition post-fire in six-monthly intervals over a three-year period.
- Count, map and tag individuals in order to assess condition of stands.
- Conduct further surveys downstream of sites, particularly in flood zone areas.
- Monitor for any evidence of disease in the population, especially for *Phytophthora cinnamomi.*

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APPENDIX 1

Assessment against *Biodiversity Conservation Regulation 2017* criteria
The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome: *Callitris oblonga* subsp. *parva* was found to be Critically Endangered under Clause 4.2(1 a)(2 a,b).

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Critically Endangered under Clause 4.2(1 a)(2 a,b).

(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
(2) - The determination of that criteria is to be based on any of the following:			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

Clause 4.3 - Restricted geographic distribution of species and other conditions
(Equivalent to IUCN criterion B)
Assessment Outcome: Endangered under Clause 4.3(b)(d)(e i,ii,iii)(f i)

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,

and at least 2 of the following 3 conditions apply:						
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,				
	(e)	there is a projected or continuing decline in any of the following:				
		(i)	an index of abundance appropriate to the taxon,			
		(ii)	the geographic distribution of the species,			
		(iii)	habitat area, extent or quality,			
		(iv)	the number of locations in which the species occurs or of populations of the species,			
	(f)	extreme fluctuations occur in any of the following:				
		(i)	an index of abundance appropriate to the taxon,			
		(ii)	the geographic distribution of the species,			
		(iii)	the number of locations in which the species occur or of populations of the species.			

Clause 4.4 - Low numbers of mature individuals of species and other conditions
(Equivalent to IUCN criterion C)
Assessment Outcome: Vulnerable under Clause 4.4(c)(d i)(e i,ii C).

The estimated total number of mature individuals of the species is:						
	(a)	for critically endangered species			very low, or	
	(b)	for endangered species			low, or	
	(c)	for vulnerable species			moderately low,	
and either of the following 2 conditions apply:						
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):				
		(i)	for critically endangered species		very large, or	
		(ii)	for endangered species		large, or	
		(iii)	for vulnerable species		moderate,	
	(e)	both of the following apply:				
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and			
		(ii)	at least one of the following applies:			
			(A)	the number of individuals in each population of the species is:		
				(I)	for critically endangered species	extremely low, or
				(II)	for endangered species	very low, or
				(III)	for vulnerable species	low,
			(B)	all or nearly all mature individuals of the species occur within one population,		
			(C)	extreme fluctuations occur in an index of abundance appropriate to the species.		

Clause 4.5 - Low total numbers of mature individuals of species
(Equivalent to IUCN criterion D)
Assessment Outcome: Not met.

The total number of mature individuals of the species is:			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)
Assessment Outcome: Data deficient.

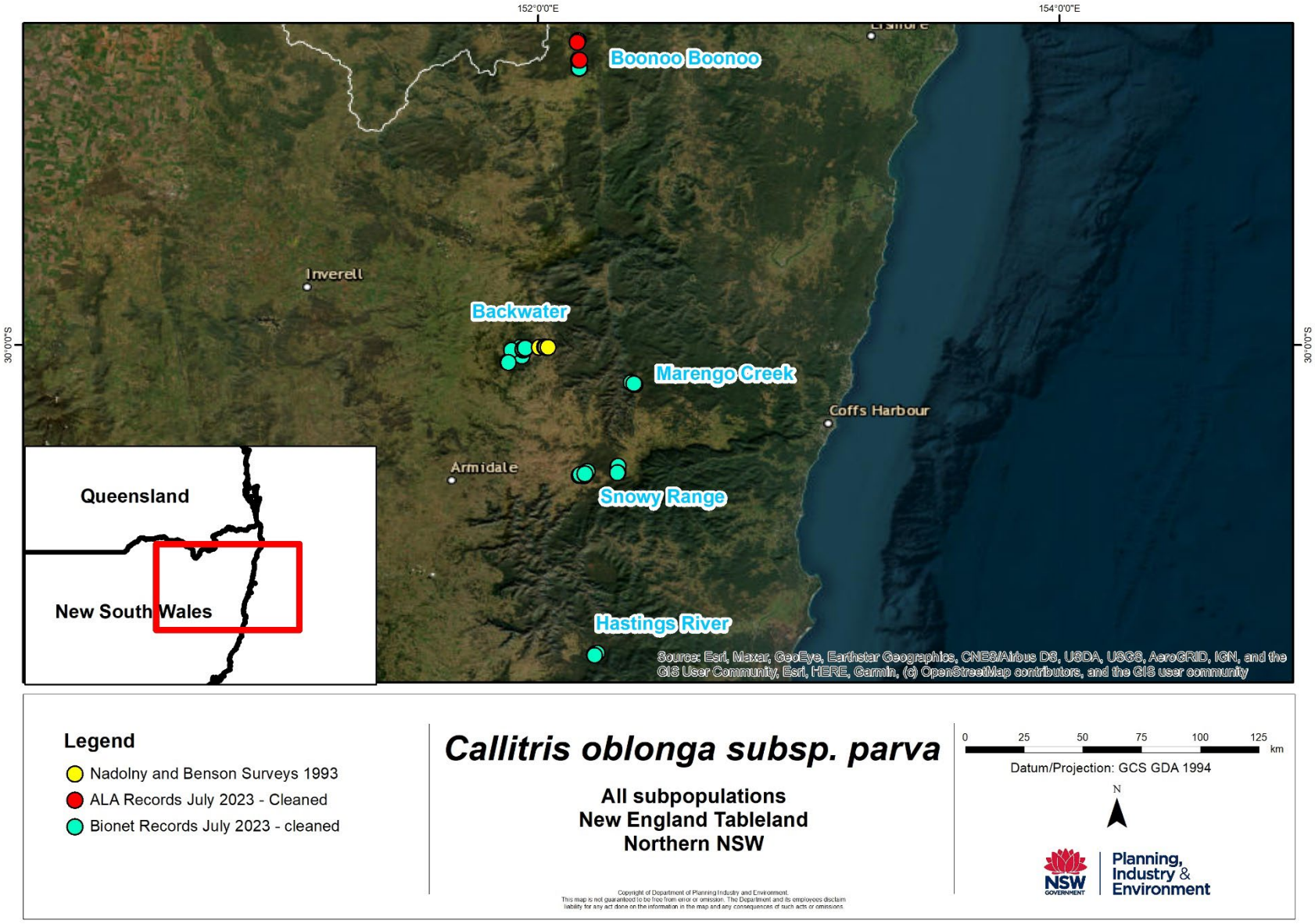
The probability of extinction of the species is estimated to be:			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

Clause 4.7 - Very highly restricted geographic distribution of species– vulnerable species
(Equivalent to IUCN criterion D2)
Assessment Outcome: Vulnerable under Clause 4.7.

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.

APPENDIX 2

Species Distribution Maps


152°0'0"E
154°0'0"E
30°0'0"S
Boonoo Boonoo
Inverell
Backwater
Marengo Creek
Coffs Harbour
Armidale
Snowy Range
Hastings River
Queensland
New South Wales
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Legend
Nadolny and Benson Surveys 1993
ALA Records July 2023 - Cleaned
Bionet Records July 2023 - cleaned
Callitris oblonga subsp. parva
All subpopulations
New England Tableland
Northern NSW
Copyright of Department of Planning Industry and Environment.
This map is not guaranteed to be free from error or omission. The Department and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions.
0 25 50 75 100 125 km
Datum/Projection: GCS GDA 1994
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NSW GOVERNMENT
Planning, Industry & Environment