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Notice of and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list *Banksia paludosa* subsp. *astrolux* A.S.George as a CRITICALLY ENDANGERED SPECIES in Part 1 of Schedule 1 of the Act. Listing of Critically Endangered species is provided for by Part 4 of the Act.

The NSW Threatened Species Scientific Committee is satisfied that *Banksia paludosa* subsp. *astrolux* A.S.George has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method, as provided by Section 4.14 of the Act. After due consideration of Commonwealth DCCEEW (2024), the NSW Threatened Species Scientific Committee has made a decision to list the species as Critically Endangered.

Summary of Conservation Assessment

Banksia paludosa subsp. *astrolux* A.S.George was found to be Critically Endangered in accordance with the following provisions in the *Biodiversity Conservation Regulation 2017*: 4.3(a)(d)(e i,ii,iii)(f i) because: 1) the species has a very highly restricted geographic distribution with an extent of occurrence of 66 km^2; 2) it is known from a single threat-defined location; 3) there are likely to be extreme fluctuations in the number of mature individuals; and 4) continuing decline in the area of occupancy, area, extent and/or quality of habitat, and number of mature individuals is inferred due to adverse fire regimes (particularly high frequency fire) and drought.

The NSW Threatened Species Scientific Committee has found that:

1. *Banksia paludosa* subsp. *astrolux* A.S.George (family Proteaceae) is a “many-stemmed shrub to 5 m high without a lignotuber; bark lightly fissured; branchlets rusty tomentose. Leaves whorled or alternate, narrow-lanceolate to narrow-obovate, 4–13 cm long, 10–30 mm wide, apex obtuse with a short mucro, base attenuate, margins entire to toothed, lower surface white-tomentose with midrib and lateral veins yellowish to brown, ± glabrescent. Conflorescences 7–13 cm long. Perianth 16–20 mm long, golden brown becoming gold after anthesis, persistent. Styles straight except for slight bend near apex, gold to cream, ± persistent. Follicles 9–18 mm long, ± widely spaced, sometimes opening when mature but often remaining closed until burnt” (PlantNet 2025).

2. *Banksia paludosa* subsp. *astrolux* is endemic to New South Wales (NSW), where it is restricted to a small area broadly northwest of Hilltop in the Sydney Basin Bioregion, Burragorang subregion (IBRA 2012). Most records are related to two main subpopulations in Nattai National Park (NP), around the Point Hill area and along Fire trails W11A and W11D. A third small subpopulation is known near the village of Balmoral.

3. The geographic distribution of *Banksia paludosa* subsp. *astrolux* is very highly restricted. The extent of occurrence (EOO) is estimated to be 66 km^2 and is based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2024). The area of occupancy

(AOO) is estimated to be 24 km^2 using 2 x 2 km grid cells, the scale recommended by IUCN (2024).

4. Based on estimates of abundance at the three known subpopulations of *Banksia paludosa* subsp. *astrolux*, the estimated population size is 1200–2600 mature individuals. This includes post-fire recruits that emerged after the 2019–2020 fires and assumes that another fire event will not occur before this cohort of plants reaches maturity.

5. *Banksia paludosa* subsp. *astrolux* is a long-lived shrub that often occurs as an understory species in woodland on sandstone soils (Baird and Benson 2021). It also co-occurs with other heath species on sandstone rock outcrops (Baird and Benson 2021). Co-occurring species include *Eucalyptus sparsifolia*, *E. sieberi*, *Leptospermum trinervium*, *Hakea dactyloides*, *Acacia linifolia*, *A. terminalis*, *Lomatia silaifolia*, *Hardenbergia violacea*, and *Lomandra obliqua* (G. Phillips pers. comm. January 2025).

6. Little is known about the ecology of *Banksia paludosa* subsp. *astrolux*, other than it has no lignotuber and is killed by fire (*i.e*., it is an obligate seeder). This species is also serotinous, with seeds being stored in woody fruits held in the canopy. Heat from a fire causes follicle opening (Huss *et al*. 2019) and the seeds are then dispersed onto the post-fire soil/ash bed and if moisture is sufficient germination can occur. However, a number of herbarium records for this subspecies note that fruits on mature plants may not hold any seeds (they are open, and seeds have been shed), suggesting a degree of spontaneous leakage from the canopy seed bank or limited serotiny independent of fire, as is characteristic of many serotinous *Banksia* species. Any seeds released will not persist in the soil, but occasional inter-fire recruitment may occur. Field inspections of *B. paludosa* subsp. *astrolux* suggests that plants may not flower until at least 5–10 (or more) years of age and that many plants in the field do not produce woody cones and hence many mature plants do not have a large canopy stored seed bank (Baird and Benson 2021; Auld 2022 unpubl. data).

7. Following severe fires, the serotinous seed bank of *Banksia paludosa* subsp. *astrolux* is exhausted at the same time as the death of parent plants, meaning that a decline in mature individuals represents a decline in the total number at this time. In such taxa, extreme fluctuations of mature individuals can arise from stochastic variation in post-fire seedling establishment. Therefore, *B. paludosa* subsp. *astrolux* is prone to extreme fluctuations in the number of mature individuals (IUCN 2024).

8. *Banksia paludosa* subsp. *astrolux* is primarily threatened by adverse fire regimes (particularly high frequency fire) and drought. Mean temperatures are projected to rise by 0.7ºC by 2030 and 2ºC by 2070, in the region where the subspecies occurs (Adapt NSW 2022). Severe fire weather is also projected to increase across the region by 2070 (Adapt NSW 2022). Time spent in drought is projected, with medium confidence, to increase over the course of the century (CSIRO 2022). The effects of climate change will likely result in increased frequency and duration of drought conditions across the range of *B. paludosa* subsp. *astrolux* and increased frequency and severity of fire. ‘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 Act.

9. *Banksia paludosa* subsp. *astrolux* is known from one threat-defined location. The 2019–2020 bushfires demonstrated that all populations can be burnt in one fire event. Fire history records (NSW DPE 2022) show that the subspecies has been exposed to multiple overlapping fires in recent decades, and is thus at risk from frequent fire across its ranges. Throughout the range of *Banksia paludosa* subsp. *astrolux,* many adult plants had shed seeds from their canopy seed bank prior to the 2019–2020 bushfires, likely due to limited serotiny, or drought effects (T. Auld pers. obs. 2022). Any seeds released spontaneously over that time would have died before or during the 2019/2020 fires, as the subspecies does not form a persistent soil seed bank. This loss of stored seeds reduced the number of seeds available for recruitment after the 2019-20 fires. A combination of frequent fire and drought can lead to dramatic local population declines in response to a fire and hence the minimum and best estimate of the number of locations is one recruitment after the 2019–20 fires. A combination of frequent fire and drought can lead to dramatic local population declines in response to a fire and hence the minimum and best estimate of the number of locations is one.

10. Continuing decline in the area of occupancy, area, extent and quality of habitat, and number of mature individuals is inferred due to adverse fire regimes (particularly high frequency fire) and drought. Field surveys after the 2019–2020 bushfires showed seedling recruitment at most sites (although recruitment levels are unlikely to be sufficient to replace all adults that were killed by the fires at a number of sites) (Baird and Benson 2021; Auld 2022 unpubl. data). Other sites had significant recruitment failure that will result in major local population declines (Baird and Benson 2021; Auld 2022 unpubl. data). A large area near Point Hill was burnt in a prescribed fire in August 2015 and all of this area, except a very small part amongst an expanse of sandstone outcrops, was also burnt in 2019–2020 (T. Auld pers. obs. 2022). It is likely that any plants in areas that were burnt twice in the last four years are now lost because seedling recruits emerging after the first fire were killed in the second fire before reaching maturity. This is consistent with field inspections in 2021 and 2022 (Auld 2022 unpubl. data) which failed to find any plants in areas burnt in both 2015 and 2019/2020.

11. *Banksia paludosa* subsp. *astrolux* A.S.George is eligible to be listed as a Critically Endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing an extremely high risk of extinction in Australia in the immediate future as determined in accordance with the following criteria as prescribed by the *Biodiversity Conservation Regulation 2017*:

Assessment against *Biodiversity Conservation Regulation* 2017 criteria

The Clauses used for assessment are listed below for reference.

Overall Assessment Outcome:
Critically Endangered under Clause 4.3(a)(d)(e i,ii,iii)(f i).

Clause 4.2 – Reduction in population size of species
(Equivalent to IUCN criterion A)
Assessment Outcome: Clause 4.2 is Data Deficient

(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: Critically Endangered under Clause 4.3(a)(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 Clause C)
Assessment Outcome: Endangered under Clause 4.4(b)(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: Not met

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.

Professor Angela Moles, FRSN
Chairperson
NSW Threatened Species Scientific Committee

Supporting Documentation:

Commonwealth DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2024) Conservation Advice for *Banksia paludosa* subsp. *astrolux*. Commonwealth DCCEEW: Canberra.

References:

Adapt NSW (2022) South east and Tablelands fire projections 2060–2079. Available at: https://www.climatechange.environment.nsw.gov.au/projections-map

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Huss JC, Fratzl P, Dunlop JWC, Merritt DJ, Miller B, Eder M (2019) Protecting offspring against fire: Lessons from *Banksia* seed pods. *Frontiers in Plant Science* **10**, 283.

IUCN Standards and Petitions Subcommittee (2024) Guidelines for Using the IUCN Red List Categories and Criteria. Version 16 [Online]. Available at: http://www.iucnredlist.org/documents/RedListGuidelines.pdf (accessed on 10 January 2025)

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