Conservation Assessment of *Atrichornis rufescens* (Ramsay, 1866) (Atrichornithidae)

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Atrichornis rufescens (Ramsay, 1866) (Atrichornithidae)

Distribution: New South Wales and Queensland
Current EPBC Act Status: Endangered
Current NSW BC Act Status: Vulnerable
Current Queensland NC Act status: Vulnerable
Proposed listing on NSW BC Act: Endangered

Reason for change: genuine change in extinction risk due to rapid population declines from fire and drought.

Summary of Conservation Assessment

Atrichornis rufescens was found to be eligible for listing as Endangered under IUCN Criteria A2bc; C1.

The main reasons for this species being eligible are: (1) it has a low total number of mature individuals (estimated at 2,050) and (2) drought from 2017–2019 followed by fires in 2019–2020 are inferred to have resulted in a large reduction in population size (58% decrease), with a 29% decrease occurring within one generation (3.2 years).

Atrichornis rufescens in Willi Willi National Park, NSW. Photo: Ian Kerr.

Description and Taxonomy

The rufous scrub-bird *Atrichornis rufescens* (Ramsay, 1866) is characterised as a small dark ground-dwelling bird with short and rounded wings, a long and rounded tail, strong legs, and a short wedge-shaped bill merging into a long flat forehead to give a characteristically triangular head profile (Higgins *et al.* 2001). Sexes differ in adult and immature plumages but are similar when juvenile (Higgins *et al.* 2001). There is no seasonal variation and only slight geographical variation in plumage and size (Higgins *et al.* 2001). Plumage is described as "adults mostly dark rufous-brown with faint darker barring, and with buff belly; male has obvious blackish triangle on chin, throat and breast joining large blackish patches on sides of upper belly, and bold white malar stripe along sides of chin and throat; female more buff below, with much smaller dark triangle (restricted to throat) and smaller dark patches on sides of belly. Juvenile plainer than adults: warmer dark red-brown and less clearly barred above, and uniformly light red-brown below, merging to greyish on chin and throat. Immatures similar to respective adult sexes; male separable in close view" (Higgins *et al.* 2001). Calls are diagnostically rich and powerful. Adults are 17 cm (17–18.5) in length with a wingspan *c*. 19 cm (Higgins *et al.* 2001).

Ramsay (1866) first described *Atrichornis rufescens* from male specimens obtained from the Richmond River in New South Wales (NSW) under the name *Atrichia rufescens*. The generic name *Atrichia* was then superseded by *Atrichornis* Stejneger, 1885 (Schodde and Bock 2008). There are two recognised subspecies of *Atrichornis rufescens*: *A. r. rufescens*, the northern variant, and *A. r. ferrieri*, the southern variant (Higgins *et al.* 2001). *Atrichornis r. rufescens* can be distinguished from *A. r. ferrieri* by having a tarsus *c.* 21–23 mm long, and song strophes 11–12 per phrase, delivered rapidly with a little upward inflection (tarsus *c.* 19–21 mm long; song strophes 7–8 per phrase, delivered less rapidly, with a marked upward inflection in *A. r. ferrieri*) (Schodde and Mason 1999). This combined species-level assessment includes both subspecies.

Atrichornis r. tweedi and *A. r. jacksoni* are synonyms of *A. r. rufescens* (AFD 2022). Other common names include eastern scrub-bird, mockingbird, mousebird, and mysterybird (Higgins *et al.* 2001); however, *A. rufescens* is not closely related to mockingbirds (family Mimidae) or mousebirds (Coliidae), both of which occur outside of Australia.

It has been proposed that *Atrichornis rufescens*, and its only extant congener, *A. clamosus* from Western Australia, are arguably the most endangered and evolutionarily distinctive relict taxa in the entire Australian avifauna (Mitchell *et al.* 2021). The two species form a small, endemic passerine family, the Atrichornithidae (Mitchell *et al*. 2021), which is most closely related to *Menura* species (lyrebirds) (Bock and Clench 1985; Chesser and Have 2007). The Atrichornithidae is a relictual Gondwanan family that is thought to have diverged from the lyrebird family (Menuridae) during the Oligocene (Oliveros *et al*. 2019), ~28.7 million years ago (Mya), with the two *Atrichornis* species having diverged during the mid- to late Miocene, ~11.1 Mya (Mitchell *et al*. 2021).

Distribution and Abundance

Atrichornis rufescens is endemic to New South Wales (NSW) and Queensland where it occurs in the New England Tablelands, NSW North Coast, and South East Queensland bioregions (Fig. A1; Commonwealth DCCEEW 2012). Both subspecies

are currently known to occur east of the Great Dividing Range at elevations above 600 m (Higgins *et al.* 2001). The nominate subspecies is localised in extreme southeast Queensland and far northeast NSW, from Mistake Range in Queensland to south of the Gibraltar Range in NSW. Subspecies *ferrieri* occurs in central northeast NSW, from Dorrigo Plateau south to Barrington Tops (Higgins *et al.* 2001). The species' former range included lowland and coastal areas, but it is thought to be extinct in areas below 400 m above sea level (a.s.l.), and possibly below 600 m a.s.l., since European settlement (Smith 1977; Ferrier 1985; Higgins *et al.* 2001). It is also thought to be extinct around Wollumbin/Mount Warning, NSW, where it was recorded in 1933 (Higgins *et al.* 2001).

Atrichornis rufescens is known to occur on the traditional lands of the Dhanggati, Geawegal, Gumbaynggirr, Wonnarua, Worimi, Bundjalung, Githabul, Ngarabal, Yugambeh, and Biripi peoples (AIATIS 1996; Stewart *et al.* 2021; Stuart *et al.* 2021).

Atrichornis rufescens occurs in an estimated seven subpopulations, as defined by the IUCN (2024) (Table 1). *Atrichornis rufescens rufescens* has four recognised subpopulations: Lamington/Border Ranges, Gibraltar Ranges, Mount Barney, and Main Range (D. Stewart pers. comm. June 2024). *Atrichornis r. ferrieri* has three recognised subpopulations, all in NSW: Barrington Tops, Hastings Range, and Ebor/Dorrigo (Ferrier 1984; Stuart *et al.* 2021).

Table 1. Population of *Atrichornis rufescens* by subspecies and subpopulations. Estimates are from Stuart *et al.* (2021) and I. Gynther, M. Mathieson, and D. Stewart *in litt.* (July 2025).

Subspecies	Subpopulation	Tenure	Estimated number of mature individuals in 2020
Atrichornis rufescens rufescens	Main Range	Queensland National Park	At least 2
Atrichornis rufescens rufescens	Mount Barney	NSW National Park; Queensland National Park	At least 10
Atrichornis rufescens rufescens	Lamington/Border Ranges	Queensland National Park; NSW National Park; NSW Nature Reserve	348
Atrichornis rufescens rufescens	Gibraltar Range	NSW National Park; NSW State Forest	170
Atrichornis rufescens ferrieri	Ebor/Dorrigo	NSW National Park; NSW Nature Reserve; NSW State Forest; freehold	550
Atrichornis rufescens ferrieri	Hastings Range	NSW National Park; NSW State Conservation Area; NSW State Forest	460
Atrichornis rufescens ferrieri	Barrington Tops	NSW National Park	510
	Total		**At least 2,050**

Subpopulations are delineated by clusters of records separated by more than 15 km. Clusters of records separated by ≤15 km and linked by contiguous vegetation (at elevations mostly above 600 m) are considered to comprise a single subpopulation.

Although *Atrichornis rufescens* typically occurs above 600 m a.s.l. (Morris *et al.* 1981), a juvenile was caught at Pappinbarra, NSW in 1987 at an altitude of 240 m (Boles and Tynan 1995), at least 20 km from nearest suitable breeding habitat (Higgins *et al.* 2001). It is probable that juveniles transit through habitat unsuitable for breeding, but their range is difficult to determine due to their cryptic behaviour (Ekert 2005a, 2005b). This suggests that records separated by lower elevation areas alone (300–600 m a.s.l.) may exchange some migrants, although the frequency of migration is uncertain. The congeneric *Atrichornis clamosus* has been shown to be capable of dispersing up to 10 km (Danks 1991). These two observations suggest a potential dispersal distance of up to 10–20 km. However, given the unusual circumstances of the Pappinbarra record, a maximum long-term dispersal distance of 15 km is considered more probable, and this value is used to help delineate subpopulations.

Subpopulations

The Main Range subpopulation is known only from Main Range National Park (NP) around the upper reaches of Dalrymple Creek, Mount Cordeaux, Mount Mitchell and Cunninghams Gap, Queensland (Stewart *et al.* 2021). Areas adjacent to the national park that previously supported the species are burnt annually or biennially, which maintains open cattle grazing land not suitable for *A. rufescens* (DES 2018).

The Mount Barney subpopulation occurs within Mount Barney NP, Queensland, and Mount Nothofagus NP, NSW. Although high-elevation vegetation links Mount Barney to the Main Range, distances of almost 25 km between these occurrences are likely to preclude regular genetic interchange (D. Stewart pers. comm. June 2024), supporting their interpretation as separate subpopulations.

The Lamington/Border Ranges subpopulation occurs within Lamington and Springbrook NPs in Queensland and Border Ranges NP in NSW (D. Stewart pers. comm. June 2024). Lamington and Border Ranges NPs are linked by extensive high-elevation vegetation, while Springbrook NP is linked to Lamington by a narrow corridor of lower elevation (300–600 m a.s.l.) vegetation.

The Gibraltar Range subpopulation occurs predominantly in Gibraltar Range, Washpool, and Barool NPs (Stewart *et al.* 2021), with records also occurring in the adjoining Moogem, Gibraltar Range, and Mount Mitchell State Forests (SFs), all west of Grafton, NSW.

The Ebor/Dorrigo subpopulation is centred around the Dorrigo and Ebor Plateaux (Stuart *et al.* 2021) in New England, Gumbaynggirr, and Cunnawarra NPs, Baalijin Nature Reserve, and Oakes, Roses Creek, Styx River, and Thumb Creek SFs. It also occurs in heavily vegetated areas of one or two private properties near the northern boundary of New England NP. Several clusters of records on the eastern edge of this subpopulation are separated by areas of lower (400–600 m a.s.l.) vegetation.

The Hastings Range subpopulation occurs within Werrikimbe, Cottan-Bimbang, Oxley Wild Rivers, Willi Willi, and Carrai NPs, and Carrai State Conservation Area, with one record from Doyles River SF. Likely habitat also occurs in adjacent state forests, including Carrai, Mt Boss, and Enfield SFs.

The Barrington Tops subpopulation occurs in Barrington Tops NP, predominantly around Gloucester Tops (Kyte and Little 2021). Historical records exist in Barrington SF and Stewarts Brooks SF, where the species has not been documented for over two decades and four decades, respectively.

Extent of occurrence and area of occupancy

The extent of occurrence (EOO) and area of occupancy (AOO) were calculated using records of the species since 1990, as per Stewart *et al.* (2021) and Stuart *et al*. (2021). The EOO is calculated at 36,531 km^2, based on a minimum convex polygon enclosing all mapped occurrences of the species, the method of assessment recommended by IUCN (2024). The AOO is estimated to be 589 km^2, being the median value of two different AOO estimates. An upper AOO estimate was derived using 2 x 2 km grid cells, the scale recommended by IUCN (2024), and records of the species since 1990, resulting in an AOO of 768 km^2. A lower AOO estimate considers the effects of the 2019–2020 fires. The 2019–2020 fires are estimated to have burnt 37% of all 1 x 1 km grid squares from which *Atrichornis rufescens rufescens* has been recorded since 1990 (Stewart *et al.* 2021) and 52% of all 1 x 1 km grid squares from which *A. r. ferrieri* has been recorded since 1990 (Stuart *et al.* 2021). Based on the intersection of 2 x 2 km grid squares encompassing all records and estimated survival, minimum estimates of AOO for each subspecies are 110 km^2 and 300 km^2, respectively (Stewart *et al.* 2021; Stuart *et al.* 2021). Combining these estimates gives a minimum estimated AOO of 410 km^2 for the species. However, given 4–5 years has passed since the 2019–2020 fires and there is some evidence of population recovery and recolonisation of burnt habitat (*e.g*., Hawkins 2022a, 2022b; Kerr *et al.* 2023a), the minimum AOO of 410 km^2 is a likely underestimation of the current AOO. Similarly, the upper estimate of 768 km^2 is likely to be an overestimation of the current AOO. The EOO and AOO were calculated using ArcGIS (Esri 2015) and based on cleaned spatial datasets from BioNet, Atlas of Living Australia, WildNet, and eBird (ALA 2024a, 2024b, 2024c; BioNet 2024; eBird 2024; WildNet 2024).

A total of 6,477 records were analysed, of which 2,915 were database duplicates. To ensure consistency with Stewart *et al.* (2021) and Stuart *et al.* (2021), a further 303 recorded prior to 1990 were excluded from the calculation. A further 113 records were considered to be of dubious accuracy and excluded through a combination of expert elicitation (A. Stuart *in litt.* June 2024; B. Hawkins *in litt.* June 2024; D. Stewart pers. comm. June 2024; M. Andren pers. comm. June 2024) and published literature (Kyte and Little 2021). Seventeen records lacked spatial information and 147 records were survey records with zero individuals recorded. This left 2,982 unique and valid records, including one record for which the coordinates were revised based on its locality description.

Population size and trends

The population is currently estimated to include 2,050 (1,850–2,690) mature individuals, with pervasive drought conditions from 2017–2019 followed by fires in 2019–2020 inferred to have resulted in a 58% (45–62%) decline in the population size of the species (Table 2; Stewart *et al.* 2021; Stuart *et al.* 2021). Ferrier (1984) estimated the population size of *Atrichornis rufescens* to be around 4,900 mature individuals across 2,450 territories: *Atrichornis r. rufescens* was estimated to occupy ~731 territories and number approximately 1,460 mature individuals, while *A. r. ferrieri* was estimated to occupy ~1,722 territories and number approximately 3,440 mature individuals. In 2020, *A. r. rufescens* was estimated to have a population size of 530 mature individuals (range 480–740) (Stewart *et al.* 2021), while *A. r. ferrieri* was estimated to have a population size of 1,520 mature individuals (1,370–1,950). Since the declines from 2017–2019, the population is unlikely to have recovered substantially (D. Stewart pers. comm. June 2024).

The combined effects of drought and fire are inferred to have led to a 64% decline (49–67%) in the population size of *Atrichornis r. rufescens* in the last decade, with declines greatest at Main Range and Gibraltar Range (Stewart *et al.* 2021). The estimated decline in NSW is likely to be similar to this national estimate (Table 2). Losses in the Lamington and Border Ranges subpopulations were due almost entirely to drought and so may be cyclic (Stewart *et al.* 2021). Similarly, the combined effects of drought and fire are inferred to have led to a 56% decline (43–60%) in the population size of *A. r. ferrieri* in the last decade, with declines greatest in the Hasting Range subpopulation (Stuart *et al.* 2021). Losses in the Barrington Tops subpopulation were almost entirely due to drought (Stuart *et al.* 2021).

Prior to the recent declines from drought and fire, the population size of *Atrichornis rufescens* was thought to have remained relatively stable since Ferrier's (1984) initial population estimates (Stewart *et al.* 2021; Stuart *et al.* 2021). *Atrichornis r. rufescens* appears to have remained stable up to at least 2015, based on observations from Ekert (2005a, 2005b), Hill (2010, 2018), and Newman *et al.* (2014). Similarly, *A. r. ferrieri* appears to have remained stable up to 2016, based on annual monitoring at Barrington Tops (Newman and Stuart 2011; Stuart and Newman 2018), with the subspecies remaining stable in the Ebor/Dorrigo subpopulation up to 2018 (Andren 2016; Andren *et al.* 2022). The exceptions to this were in parts of the Hastings and Gibraltar Ranges, where declines from fires had been documented from around 2000 onwards (Hawkins 2022a, 2022b).

Observations of *Atrichornis r. rufescens* in Border Ranges NP (Hill 2018, Hill 2019) and Lamington NP (DES 2018), coupled with annual monitoring of *A. r. ferrieri* at Barrington Tops (Stuart 2020), led researchers to conclude that drought had caused a 29% decline of the species' total population size by 2019 (Table 2; Stewart *et al.* 2021; Stuart *et al.* 2021). However, monitoring of the Ebor/Dorrigo subpopulation suggests drought effects were not homogeneous across the species' range, with territory occupancy remaining stable through to 2018 (Andren *et al*. 2022), contrasting with the marked decreases observed in Barrington Tops and Border Ranges (Stuart 2020; Hill 2023). Despite this, drought conditions continued into 2019, resulting in an estimated population decline on par with the other subpopulations (M. Andren pers. comm. June 2024).

Fires in 2019–2020 were estimated to have led to further declines in both subspecies (Table 2). Based on fire severity in occupied habitat and estimates of mortality at different severity classes (severity class 2: 20%; class 3: 50%; class 4: 100%; class 5: 100%), approximately 49% (28–54%) of the *A. r. rufescens* population is likely to have been reduced by fire (Stewart *et al* 2021). Using the same rationale, approximately 37% (20–44%) of the *A. r. ferrieri* population is likely to have been reduced by fire (Stuart *et al.* 2021). Multiple post-fire surveys in the Ebor/Dorrigo, Hastings Range, and Gibraltar Range subpopulations have confirmed widespread decreases in territory occupancy and loss of habitat from the 2019–2020 fires (Charley 2021; DPIE 2021; Kerr 2021; Spark 2021; Kerr *et al.* 2023a).

Long-term monitoring from Border Ranges (2010–2023) and Barrington Tops (2010–2019) has found that substantial interannual fluctuations can occur in territory occupancy and territory density, but there appears to have been a trend of decline over time (Stuart 2020; Hill 2023).

Table 2. Population decline from drought and fire from 2017–2020. Overall decline has been recalculated from available data.

Subspecies	Subpopulation	Pre-drought population size	Post-drought population size (29% decline)	Post-fire population size	Estimated % decline from fire	Overall % decline from fire and drought
Atrichornis rufescens rufescens	Main Range (Queensland)	14	10	At least 2	80%	85.7%
Atrichornis rufescens rufescens	Mount Barney (Queensland)	-*	-*	At least 10	-*	-
Atrichornis rufescens rufescens	Lamington/ Border Ranges (Queensland / NSW)	510	362	348	3.9%	31.8%
Atrichornis rufescens rufescens	Gibraltar Range (NSW)	944	670	170	74.6%	82%
Atrichornis rufescens ferrieri	Ebor/Dorrigo (NSW)	910	646	550	14.9%	39.6%
Atrichornis rufescens ferrieri	Hastings Range (NSW)	1,790	1,270	460	63.8%	74.3%
Atrichornis rufescens ferrieri	Barrington Tops (NSW)	740	525	510	2.9%	31.1%
	Total	**4,908**	**3,483**	**2,050**	**41.1%**	**58.2%**

***** Forty one percent of the rufous scrub-bird's potential habitat in Mount Barney NP was burnt during the 2019-2020 bushfires (Hines *et al*. 2022).

Ecology

Habitat

Atrichornis rufescens is confined to high-elevation areas dominated by subtropical, warm temperate, and cool temperate rainforests, wet eucalypt forests, and the ecotones of these forest types (Robinson 1977; Ferrier 1984; Ferrier 1985). The northern subspecies is confined to subtropical, warm temperate and cool temperate rainforests (Stewart *et al.* 2021), while the southern subspecies occurs most commonly in wet eucalypt forests, but will also utilise subtropical, warm temperate and cool temperate rainforest (B. Hawkins *in litt.* July 2024). Within these forest types, habitat for *A. rufescens* is comprised of a combination of very dense ground cover, a moist microclimate, and deep leaf litter (Ferrier 1984; Ferrier 1985). Groundcover may include ferns, shrubs, vines, sedges, logs, and other debris (Ferrier 1985).

Habitat for *Atrichornis rufescens* is influenced by the amount of light penetrating the canopy, with gaps in the canopy allowing for light to reach the ground and facilitating the development of dense ground cover (Ferrier 1984). Areas regenerating from fires or storms are also often suitable for *A. rufescens* (Stewart *et al.* 2021; Stuart *et al.* 2021). However, time since fire, fire severity, and annual rainfall influence the speed of post-fire habitat recovery (B. Hawkins *in litt.* July 2024). In rainforest, habitat

suitability decreases as successional communities develop after disturbance, as the density of groundcover decreases (Ferrier 1985).

Atrichornis rufescens formerly occupied lowland rainforests (below 600 m a.s.l.) such as the Big Scrub near Lismore, where it was noted to be more common compared to its montane distribution (Smith 1977). However, it is now mostly confined to elevations above 600 m (Ferrier 1985; Garnett and Franklin 2014; Stewart *et al.* 2021; Stuart *et al.* 2021). The cause of this upwards retreat is unknown (Ferrier 1985) but may be due to the clearing of lowland habitat for agriculture (Ferrier 1984).

Behaviour

Atrichornis rufescens is a sedentary (*i.e.*, non-migratory) and diurnal species (Higgins *et al.* 2001; DESI 2024). It is exceptionally shy and cryptic, usually seen singly or occasionally in twos, but more often heard than seen (Ferrier 1985; Higgins *et al.* 2001). The species is predominantly ground dwelling, seldom flying, and incapable of sustained flight when it does (Jackson 1920; Ferrier 1985; Higgins *et al.* 2001). Birds are described as scurrying 'mouse-like' when moving quickly (Jackson 1921).

Atrichornis rufescens has a loud and penetrating call (Higgins *et al.* 2001) and is known to mimic a range of other bird species, such as the grey goshawk (*Accipiter novaehollandiae*), Lewin's honeyeater (*Meliphaga lewinii*), eastern yellow robin (*Eopsaltria australis*), and Australian logrunner (*Orthonyx temminckii*) (Jackson 1921).

Breeding and social organisation

The breeding season for *Atrichornis rufescens* mostly occurs from September to December but may start as early as August and continue to as late as February (Ferrier 1985; Andren 2016; DESI 2024). Breeding males occupy permanent territories, ranging from 0.5–1.7 ha in area (Ferrier 1984; Stuart 2018). Territories are well-spaced, with a maximum of 4–6 territories per square kilometre, either as a function of social spacing mechanisms or the availability of suitable habitat (Ferrier 1984, 1985). Turnover of territories appears to be slow, occurring on average every three years, with some territories remaining continuously occupied for decades, suggesting successive occupancy by multiple males (Andren *et al.* 2022). In *Atrichornis clamosus*, several silent subordinate males reside within the territory of a dominant vocal male and will rapidly assume dominance when the dominant male is removed (Berryman 2007). Whether this occurs in *A. rufescens* is not known; one small study found that the disappearance of two males from their long-term territories did not result in successive occupancy, indicating an absence of other males waiting to occupy those territories (Stuart 2019). Short-term territories (occupied for 1–3 years) have been documented (Stuart and Newman 2018; Andren *et al.* 2022) and ephemeral (non-breeding) males may defend short-term territories at the beginning of the breeding season, typically in suboptimal habitat (Ferrier 1985). Juveniles are likely to disperse in search of territories, including through habitat unsuitable for breeding (Ekert 2005a, 2005b).

Most calling is territorial and done by territorial males (Ferrier 1984). Males have a loud and penetrating call that can be heard up to 150 m away in good conditions, while females make a soft call, which only carries a few metres (Ferrier 1984). Territorial calling occurs throughout the day (Stuart *et al.* 2022) and peaks during mid-September to December, dropping off in January and February, and remaining variable and less frequent from February to August (O'Leary and Stuart 2021).

It is uncertain whether *Atrichornis rufescens* forms pair bonds, but it has been suggested that the species is polygynous, with males and females holding contiguous and somewhat overlapping territories (Schodde 1996). Conversely, Ferrier (1985) reported that a single female occupies a small breeding area at the periphery of each male's territory.

Females alone undertake nest-building, egg incubation, and feeding of chicks (Ferrier 1985). The dome-shaped nests are built close to the ground and are composed of dead leaves and grass lined with a cardboard-like wood pulp on the inside (Jackson 1921; Ferrier 1985). Nests have been recorded to measure 15–19 cm in diameter and have a side entrance a few centimetres wide (White 1920; Jackson 1921). Clutches are comprised of two eggs and incubation is thought to be 36–38 days (Ferrier 1985). Fledglings leave the nest 3–4 weeks after hatching but continue to be fed by the mother for at least another three weeks (Ferrier 1985). Breeding typically takes place only once a year (Ferrier 1985).

Diet

Little is known about the diet of *Atrichornis rufescens* (Higgins *et al*. 2001), though Jackson (1921) reported that the species consumed a variety of invertebrates, including weevils (Curculionidae), longhorn beetles (Cerambycidae), amphipods in the genus *Arcitalitrus*, and snails and snail eggs (Vitrinidae). Foraging occurs in moist leaf litter under dense vegetation and debris, with the bill and head used to toss aside leaves in search of food (Higgins *et al.* 2001; A. Stuart *in litt*. June 2024).

Lifespan and generation length

Age at first breeding in *Atrichornis rufescens* is estimated to be 1.5 years, with a maximum longevity of 8 years, and a generation length of 3.2 (2.4–4.0) years (Bird *et al.* 2020).

Threats

Atrichornis rufescens is threatened by adverse fire regimes (particularly high frequency and high severity fire), drought, and the interaction of drought and fire. Habitat loss and disturbance from forestry activities may also threaten the species where it occurs within state forests. Predation by feral cats (*Felis catus*) is likely, given the species' life-history traits and habitat.

Adverse fire regimes

Atrichornis rufescens is threatened by high frequency and high severity fire regimes that cause habitat loss and mortality (Ferrier 1984; Stewart *et al.* 2021; Stuart *et al.* 2021; Andren *et al.* 2022), with high frequency fire and high severity fire posing the greatest risks of habitat loss and population declines to the species. Following population declines from prolonged antecedent drought conditions, the 2019–2020 fires are inferred to have led to a further ~41% decline in the population size of the species. Declines of ~49% (28–54%) in the *A. r. rufescens* population and ~37% (20–44%) in the *A. r. ferrieri* population were inferred based on fire severity in the area occupied by the species and estimates of mortality at different severity classes (Table 1; Stewart *et al.* 2021; Stuart *et al.* 2021). The Main Range, Gibraltar Range, and Hastings Range subpopulations were most affected (Table 2).

Approximately 48.7% of potential *Atrichornis rufescens* habitat in the Main Range area (Hines *et al.* 2021) and up to 80–90% of known habitat within the Gibraltar and

Hastings Ranges (Spark 2021) are estimated to have been burnt as a result of the 2019–2020 fires. The Mount Barney subpopulation may also have been affected, with 41% of the species' potential habitat in Mount Barney NP burnt during the 2019–2020 fires (Hines *et al*. 2022) and 39% of the Gondwana Rainforests of Australia World Heritage Area (GRAWHA) within Mount Nothofagus National Park estimated to have been fire-affected (DAWE 2020). In the Hastings Range, entire hillsides of immature rainforest at one locality were burnt, along with the drier ecotones of rainforest edges and groundcover deeper within rainforest as result of leaf litter fires (Spark 2021). Long-term research plots in Werrikimbe and Willi Willi NPs that had historically supported *A. rufescens* showed evidence of ongoing attrition and an absence of regeneration when revisited in the second half of 2020 (Peacock and Baker 2022).

Post-fire surveys in the Hastings Range, Gibraltar Range, and Ebor/Dorrigo subpopulations documented widespread declines in territory occupancy (Table 3). Subsequent surveys in the Hastings Range and Gibraltar Range subpopulations suggest some population recovery is occurring, although different survey methods and variance in the exact areas surveyed mean results from different surveyors are not directly comparable.

Table 3. Post-fire surveys in the Hastings Range, Gibraltar Range, and Ebor/Dorrigo subpopulations.

Subpop.	Locality	Date of survey	Number of sites	Number of historical sites	Number of sites burnt	Occupied territories across all sites surveyed	Refs.
Hastings Range	Cottan-Bimbang / Werrikimbe / Oxley Wild Rivers / Willi Willi / Carrai	Oct & Dec 2020	38	34	31	**7*** (5 in Oxley Wild Rivers NP; 2 in Willi Willi NP)	Spark 2021
Hastings Range	Werrikimbe / Oxley Wild Rivers / Willi Willi	Oct 2020 to Jan 2021	45	43	34	**9***	Charley 2021
Hastings Range	Werrikimbe / Willi Willi / Cottan-Bimbang	Oct-Nov 2021	59	58	Not stated	**12** (7 in Werrikimbe NP; 4 in Willi Willi NP; 1[#] in Cottan-Bimbang NP)	Kerr 2021
Hastings Range	Werrikimbe / Oxley Wild Rivers / Carrai	Oct 2022	Most sites in Spark (2021) and Charley (2021)	Not stated	Not stated	**12** (6 in Oxley Wild Rivers NP, 4 in Werrikimbe NP, 1 in Willi Willi NP, 1 in Carrai NP; 7 territories were sites where the species had not been recorded since the fires)	Hawkins 2022a
Hastings Range	Cottan-Bimbang / Willi Willi / Werrikimbe	Nov & Dec 2023	55	55	Not stated	**22** (2 in Cottan Bimbang NP; 4 in Willi Willi NP; 16 in Werrikimbe NP)	Kerr *et al.* 2023a, 2023b

Subpop.	Locality	Date of survey	Number of sites	Number of historical sites	Number of sites burnt	Occupied territories across all sites surveyed	Refs.
Gibraltar Range	Gibraltar / Washpool / Barool / Moogem	Sept 2020	48	46	34	**7** (5 in Gibraltar Range NP, 2 in Washpool NP)	Spark 2021
Gibraltar Range	Gibraltar / Washpool / Barool	Sept 2022	Most sites in Spark (2021)	Not stated	Not stated	**6** (3 in Washpool NP – all different to 2021; 3 in Gibraltar Range NP)	Hawkins 2022b
Ebor/ Dorrigo	New England NP	2020	20	20	7	**7**	DPIE 2021
Ebor/ Dorrigo	New England – Petroi Plateau / Mount Killiekrankie	Oct 2020 to Jan 2021	49	40	27	**5** (4 on Petroi Plateau – 2 in historical territories; 1 around Mount Killiekrankie – an unburnt historical territory)	Charley 2021

*possibly the same territories recorded, as surveys targeted historical record locations and resulted in similar locations of occupied territories.
#*c.f.* with 6 in 2014.

Insectivorous birds have been found to be less abundant in burnt rainforest relative to unburnt rainforest one year after fire, suggesting slow recovery and high vulnerability to fire (Lee *et al.* 2022). Stuart and Newman (2018) found it can take at least 6–7 years for burnt habitat to regain suitability for *Atrichornis rufescens*. However, surveys in 2022 and 2023 in the Hastings Range and Gibraltar Range subpopulations found areas affected by high severity fire were being reoccupied ~2–3 years post-fire (Hawkins 2022a, 2022b; B. Hawkins *in litt.* July 2024), suggesting post-fire conditions may have influenced the speed of vegetation recovery. The 2019–2020 fires were followed by three wet years which promoted vegetation recovery (B. Hawkins *in litt.* July 2024). However, reoccupancy of recovering habitat is probably dependent on surviving *A. rufescens* being nearby, with rainforest likely being utilised as refugia during and after a fire (B. Hawkins *in litt.* July 2024). Without surviving individuals nearby, reoccupancy of former habitat is likely to be slow (B. Hawkins *in litt.* July 2024).

High frequency fire has also been implicated in population declines of *Atrichornis rufescens*. In the central parts of the plateaux in the Gibraltar Range and Carrai Plateau – once regarded as *A. rufescens* hotspots – recurrent fires appear to have led to the loss of the species a decade or more prior to the 2019–2020 fires (Gibraltar Range burnt in 2002 and 2014, and Carrai Plateau in 2003, 2007, 2009, and 2013; B. Hawkins *in litt.* July 2024). With these central plateau areas ≥5 km from the nearest rainforest refugia, the low reproduction rates of *A. rufescens* suggest that the species could potentially take decades to expand 5 km from their rainforest fire refugia into the unoccupied but suitable habitat in the central plateau areas (B. Hawkins *in litt.* July 2024).

Very low frequency fire may also be a threat to *Atrichornis rufescens*. Ferrier (1984, 1985) suggested that prolonged exclusion of fire from wet eucalypt forests may result in them transitioning into rainforest, thereby rendering these areas less suitable to the species through a reduction in ground cover density.

Climate change projections indicate a future trend of increased fire weather and more frequent fires in southeast Australia (Dowdy *et al*. 2019; Jones *et al*. 2022). The Hunter, North Coast, and New England and North West regions in New South Wales and the Southern Downs and Scenic Rim LGAs in Queensland are projected to become hotter, have more high-fire-danger days, have more hot days over 35°C, have fewer cold nights under 2°C, and have a longer fire season by 2079 (BOM and CSIRO 2024; AdaptNSW 2024a; CSIRO 2024; The Long Paddock 2024). It is plausible that these changes will lead to more frequent, intense, and severe fires, and changes in fire season, which will in turn adversely affect the *Atrichornis rufescens* population in the future.

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*. 'Fire regimes that cause declines in biodiversity' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*.

Drought

Drought is a serious threat to *Atrichornis rufescens* and was estimated to have caused a population decline of 29% across the species' range from 2017–2019 (Stewart *et al.* 2021; Stuart *et al.* 2021). The species is confined to high-elevation areas dominated by wet eucalypt forests, and subtropical, warm temperate, and cool temperate rainforests, where it requires deep leaf litter and a moist microclimate to survive (Robinson 1977; Ferrier 1984; Ferrier 1985). Drought is likely to adversely affect *A. rufescens* by desiccating habitat and reducing populations of the invertebrate prey living in the deep, usually moist leaf litter, with subsequent population declines due to a lack of food availability (M. Andren pers. comm. June 2024). In 2019, moisture readings from leaf litter in rainforest areas in the mid north coast of NSW were similar to those of far western NSW (DE 2021), highlighting the extent to which drought had rendered habitat unsuitable for *A. rufescens* during the 2017–2019 drought.

Annual monitoring in Barrington Tops and Border Ranges has found drought leads to rapid decreases in territory occupancy and territory density (Newman *et al.* 2014; Stuart 2020; Hill 2023). In Barrington Tops, territory density declined from 5.3 territories km^{-2} in 2011 to 3.7 territories km^{-2} in 2012 and 3.2 territories km^{-2} in 2013, following dry conditions (Stuart 2020). Similarly, territory density declined from 3.7 territories km^{-2} in 2016 to 2.3 territories km^{-2} in 2019, following the 2017–2019 drought. In Border Ranges, territory density declined from 4.2 territories km^{-2} in 2011 to 2.8 territories km^{-2} in 2012 (Newman *et al.* 2014), and from 4.1 territories km^{-2} in 2015 to 2.8 territories km^{-2} in 2019 (Hill 2023). The differences observed between Barrington Tops and Border Ranges may be explained by the greater extent of rainforest refugia in the latter which may have been able to support greater numbers of *Atrichornis rufescens* during the drought periods.

Drought also threatens *Atrichornis rufescens* by predisposing normally wet habitat to fire through prolonged periods of low fuel moisture. Drought can compound the effects of fire weather – characterised by high temperatures, low humidity, and strong winds – to increase the likelihood of severe wildfire (Squire *et al.* 2019; Richardson *et al.* 2022). This interaction was highlighted by the 2019–2020 fires. While fire is normally

rare in rainforest, the antecedent drought conditions enabled large areas of rainforest to burn (Godfree *et al.* 2021; Stewart *et al.* 2021).

Regionally, time spent in drought is projected, with medium confidence, to increase over the course of the century (CSIRO 2024). Projections indicate increases in both the duration and frequency of extreme drought to 2070 (AdaptNSW 2024b; The Long Paddock 2024). It is plausible these changes will adversely affect the *Atrichornis rufescens* population in the future, both directly through reducing habitat suitability, and indirectly, by increasing the flammability of the species' habitat.

'Anthropogenic Climate Change' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*. 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat loss and disturbance from forestry activities

Forestry activities are a potential threat to *Atrichornis rufescens* (Ferrier 1984, Ferrier 1985). Records of the species occur in eight state forests in NSW, indicating that state forests have the potential to support significant areas of *A. rufescens* habitat. Timber harvesting and associated activities in *A. rufescens* habitat have the potential to cause the direct loss of territories and reduce habitat suitability, through loss of dense understorey, reduced leaf litter volume, and lower humidity at ground level due to loss of overstorey (Ferrier 1984, Ferrier 1985).

Ferrier (1985) suggested that the management of *Atrichornis rufescens* in relation to timber harvesting needs to consider two aims: the protection of existing territories from timber harvesting, and the management of remaining areas to provide adequate habitat for future maintenance and/or expansion of the *A. rufescens* population.

The Coastal Integrated Forestry Operations Approval (CIFOA) attempts to fulfil the first aim – the protection of existing territories from timber harvesting – through species-specific requirements, such as exclusion buffers around records, suitable micro-habitat protection, large reserved patches, and specific survey guidelines (NSW EPA 2018, NSW EPA 2023). However, small territory patches (particularly those <1 ha in size) may be at risk of being disturbed by timber harvesting.

Ferrier (1985) noted that the importance of the second aim – the management of remaining areas to provide adequate habitat for future maintenance and/or expansion – should not be underestimated, due to the susceptibility of habitat to natural phenomena such as fire. The CIFOA has two strands of protection mechanisms, which include: 1) the protection of habitat containing known records or territories, and 2) suitable micro-habitat identification (≥1 ha) and protection in the absence of knowledge of records. This reduces the risk of currently unoccupied habitat being modified or degraded, and the subsequent reduction in available habitat area in the event of any losses of occupied territories due to fire or other natural phenomena. Conserving potential habitat within state forests, and broadly across the species' distribution, is likely to become increasingly important to offset any losses of existing territories, especially given the estimated scale of habitat loss due to the 2019–2020 fires. Over 40% of the state forest estate is reserved and unavailable for timber harvesting across the state forest estate and managed for conservation (Slade and Law 2018), which also includes local protection zones such as wildlife habitat and tree protection clumps during operations.

Predation by feral cats *Felis catus*

Predation by feral cats is a likely threat, given the species' traits and habitat (Woinarski *et al.* 2017). Woinarski *et al.* (2017) ranked *Atrichornis rufescens* 15th out of the top 40 Australian bird species with highest relative *per capita* likelihood of being killed by cats, based on the relationship between the presence/absence of cat-predation records and bird traits. Camera trap surveys in Main Range NP in 2021 found feral cats were the most common feral animal recorded, with 90% of the observations in rainforest vegetation, two-thirds of which were from unburnt vegetation (Fisher *et al.* 2021). This suggests that *A. rufescens* is at greater risk of predation from cats following fire, as the species is more likely to be sheltering in rainforest refugia.

'Predation by the feral cat *Felis catus* (Linnaeus, 1758)' is listed as a Key Threatening Process under the *Biodiversity Conservation Act 2016*. 'Predation by feral cats' is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*.

Number of locations

Atrichornis rufescens occurs at one threat-defined location, as per the IUCN (2024) definition, due to the most serious plausible threat resulting in the lowest number of locations for the taxon being drought. Multiple historical droughts have been documented to have affected the entire species' range, including the 1982–1983 El Niño drought, the 1997–2009 Millennium drought, and the 2017–2019 drought (BOM 2024), which was estimated to have led to a 29% decline in the species' population size (Stewart *et al.* 2021; Stuart *et al.* 2021). Therefore, a single drought can operate on a scale that encompasses the entire species' distribution, resulting in a single threat-defined location.

Assessment against IUCN Red List criteria

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

Overall assessment outcome

Atrichornis rufescens was found to be eligible for listing as Endangered under IUCN Criteria A2bc; C1.

Criterion A Population size reduction

A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered	Endangered	Vulnerable
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible AND understood AND have ceased.

A2 Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years) *[(a) cannot be used for A3]*.

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation *[except A3]*

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

Outcome

Atrichornis rufescens is eligible to be listed as Endangered under Criterion A2bc.

Population reductions

Drought conditions from 2017–2019 followed by fires in 2019–2020 are inferred to have resulted in a greater than 50% decline in the *Atrichornis rufescens* population size (Table 2; Stewart *et al.* 2021; Stuart *et al.* 2021), based on 64 (49–67)% reduction in *Atrichornis rufescens rufescens* and 56 (43–60)% reduction in *A. r. ferrieri* over the past 10 years. This reduction is within the thresholds and minimum 10-year timeframe for Endangered under Criterion A2. The 10-year timeframe, rather than three generation lengths, is applied in this case because *A. rufescens* has a generation length of 3.2 (2.4–4.0) years (Bird *et al.* 2020).

Multiple post-fire surveys in the Ebor/Dorrigo, Hastings Range, and Gibraltar Range subpopulations have confirmed widespread decreases in territory occupancy and loss of habitat from the 2019–2020 fires (Charley 2021; DPIE 2021; Kerr 2021; Spark 2021). Approximately 48.7% of potential *Atrichornis rufescens* habitat in the Main Range (Hines *et al.* 2021) and 80–90% of known habitat within the Gibraltar and Hastings Ranges (Spark 2021) is estimated to have been burnt in these fires.

Criterion B Geographic range

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
	Critically Endangered	Endangered	Vulnerable
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	= 1	≤ 5	≤ 10
(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			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Outcome

Atrichornis rufescens is eligible to be listed as Vulnerable under Criterion B2ab(ii,iii,v).

EOO and AOO

The extent of occurrence of *Atrichornis rufescens* is estimated at 36,531 km^2, above the threshold for Vulnerable. The area of occupancy is estimated at 589 km^2, meeting the threshold for Vulnerable. The plausible bounds for this estimate (410–768 km^2) are mostly within the thresholds for the Vulnerable category.

Number of threat-defined locations

Atrichornis rufescens occurs in one threat-defined location, as per the IUCN definition (IUCN 2024), due to the most serious plausible threat resulting in the lowest number of locations for the taxon being drought.

Severely fragmented

Atrichornis rufescens is not considered to be severely fragmented, as it is inferred that >50% of its total AOO consists of occurrences considered sufficient to support a viable population, as per the IUCN (2024) definition.

Continuing decline

It is estimated and inferred that continuing decline is occurring in the area of occupancy, the area, extent, and quality of habitat, and the number of mature individuals, due to the combined effects of adverse fire regimes (particularly high frequency and high severity fire) and drought.

Extreme fluctuations

Atrichornis rufescens is not known or likely to undergo extreme fluctuations in its geographic distribution, number of locations or subpopulations, or population size.

Conclusion

Atrichornis rufescens is eligible to be listed under Criterion B2ab(ii,iii,v) as it is estimated to have an AOO of 589 km^2, occurs in one threat-defined location, and is estimated and inferred to be undergoing continuing decline in the area of occupancy, the area, extent, and quality of habitat, and the number of mature individuals, due to the combined effects of adverse fire regimes (particularly high frequency and high severity fire) and drought.

Criterion C Small population size and decline

C. Small population size and decline				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):		25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2. An observed, estimated, projected or inferred continuing decline AND at least 1 of the following 3 conditions:				
(a)	(i) Number of mature individuals in each subpopulation	≤ 50	≤ 250	≤ 1,000
	(ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals				

Outcome

Atrichornis rufescens is eligible to be listed as Endangered under Criterion C1.

Number of mature individuals

The current population size of *Atrichornis rufescens* is estimated to be around 2,050 mature individuals (Table 1), below the threshold of <2,500 for Endangered.

Continuing decline

Observations of *Atrichornis rufescens rufescens* in Border Ranges NP (Hill 2018, 2019) and Lamington NP (DES 2018), coupled with annual monitoring of *A. r. ferrieri* at Barrington Tops (Stuart 2020), led researchers to conclude that drought from 2017–2019 resulted in a 29% decline in the population size of the species in just three years (Stewart *et al.* 2021; Stuart *et al.* 2021). With an estimated generation time of 3.2 years (Bird *et al.* 2020), this means the species experienced a decline of >25% in a single generation, meeting the threshold for Critically Endangered. However, the population size means *A. rufescens* only qualifies for Endangered under C1.

Atrichornis rufescens has an estimated population size of 2,050 mature individuals, below the threshold for Endangered. However, while all subpopulations are estimated to support <1,000 mature individuals, several subpopulations are estimated to support

>250 mature individuals, meeting only the threshold for Vulnerable. As a result, *A. rufescens* is eligible to be listed as Vulnerable under C2a(i).

Mature individuals in each subpopulation

The largest subpopulations of *Atrichornis rufescens* are estimated to support >250 but <1000 mature individuals, meeting the thresholds for listing as Vulnerable under this sub-criterion.

% of mature individuals in a single subpopulation

No *Atrichornis rufescens* subpopulation is estimated to support 90–100% of the total population size.

Extreme fluctuations

Atrichornis rufescens is not known or likely to undergo extreme fluctuations in its geographic distribution, number of locations or subpopulations, or population size.

Conclusion

The population size estimate of 2050 mature individuals and a population decline estimated at 29% in less than three years (one generation) are within the thresholds of being eligible to be listed as Endangered under C1. However, due to the subpopulation sizes of >250 but <1,000 mature individuals, *Atrichornis rufescens* is only eligible to be listed as Vulnerable under C2a(i).

Criterion D Very small or restricted population

D. Very small or restricted population			
	Critically Endangered	Endangered	Vulnerable
D. Number of mature individuals	< 50	< 250	D1. < 1,000
D2. *Only applies to the VU category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.	-	-	D2. typically: AOO < 20 km² or number of locations ≤ 5

Outcome

Atrichornis rufescens is ineligible to be listed under Criterion D.

Number of mature individuals

The estimated population size of *Atrichornis rufescens* is around 2,050 mature individuals.

Risk of future extinction in a very short amount of time

Atrichornis rufescens has a current AOO estimated at 589 km^2, but occurs in one threat-defined location, with drought considered the most serious plausible threat that results in the lowest number of locations, as per the IUCN (2024). However, there are no plausible future threats which could drive the species to Critically Endangered or Extinct within a very short time (one to two generations)

Criterion E Quantitative Analysis

E. Quantitative Analysis			
	Critically Endangered	Endangered	Vulnerable
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Outcome

Atrichornis rufescens is Data Deficient under Criterion E.

Probability of extinction

No quantitative analysis has been undertaken to assess the extinction probability of *Atrichornis rufescens* and there are currently insufficient data to undertake one.

Conservation and Management Actions

Atrichornis rufescens is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation strategy has been developed by the NSW Department of Climate Change, Energy, the Environment and Water 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. *Atrichornis rufescens* sits within the landscape management stream of the SoS program and the conservation strategy can be viewed here.

Key actions include: liaising with land managers to ensure that occupied habitat is identified in fire planning and protected from prescribed burning and, to the extent practicable, wildfire; liaising with land managers to ensure that occupied habitat is identified in road maintenance and weed control planning; investigating the impacts of fire, disturbance and predation on the birds and their habitats; supporting and potentially expanding the monitoring program in the Border Ranges, New England, Werrikimbe and Gloucester Tops; investigating the constraints operating to restrict population size; and researching the potential impact of climate change on subpopulations and their habitats.

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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:

Atrichornis rufescens was found to be Endangered under Clause 4.2(1 b)(2 b,c) and Clause 4.4(b)(d ii).

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

(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: Vulnerable under Clause 4.3(c)(d)(e i,ii,iii)

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: Endangered under Clause 4.4(b)(d ii)

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.

APPENDIX 2 - maps

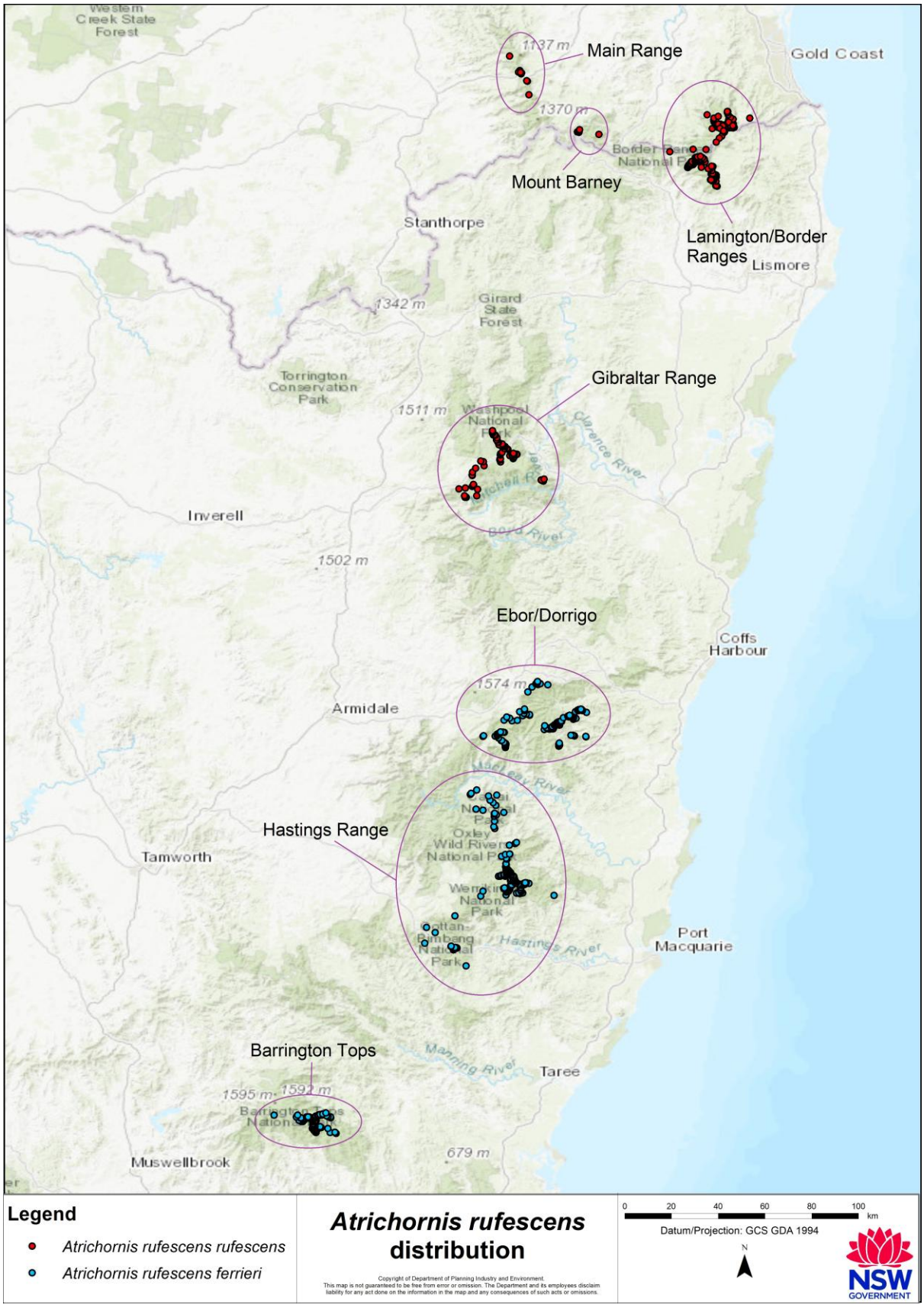

Fig. A1. Distribution of *Atrichornis rufescens*.