

NSW Threatened Species Scientific Committee

Conservation Assessment of *Bertya* sp. Chambigne NR (M.Fatemi 24) (Euphorbiaceae)

NSW Threatened Species Scientific Committee
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***Bertya* sp. Chambigne NR (M.Fatemi 24) (Euphorbiaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not listed

Current NSW BC Act Status: Endangered

Proposed listing on NSW BC Act: Endangered

The NSW Threatened Species Scientific Committee published a notice of final determination (FD) for *Bertya* sp. Chambigne NR (M.Fatemi 24) in 2007 (NSW SC 2007). This Conservation Assessment report has found that there is no change to the listing status of this taxon on the BC Act schedules. The report provides an updated assessment for the risk of extinction for the taxon against the criteria in the *Biodiversity Conservation Regulation 2017* using the Common Assessment Method. It should be read in conjunction with the 2007 FD.



Figure 1. *Bertya* sp. Chambigne NR (M.Fatemi 24). (a) Female flower, image from J.J. Bruhl (UNE), (b) RHS, Male flowers and immature fruits, image from Paul Sheringham (NSW DCCEEW). Images used with permission.

Summary of Conservation Assessment

Bertya sp. Chambigne NR (M.Fatemi 24) was found to be eligible for listing as Endangered under IUCN Criterion B1ab(v)+2ab(v).

The main reasons for this taxon being eligible are: 1) it has a highly restricted geographic distribution (estimated extent of occurrence and area of occupancy are ~881 km² and ~36 km², respectively); 2) it occurs in 4–7 threat-defined locations; and 3) continuing decline is inferred in the number of mature individuals due to high fire frequency and the probability of increased drought conditions.

Description and Taxonomy

Fatemi (2005) describes *Bertya* sp. Chambigne NR (M.Fatemi 24) as a monoecious shrub to two (rarely three) metres high (Figure 1) – see also PlantNet (2024). Branchlets are terete with a variably dense indumentum of stalked stellate hairs. Leaves are petiolate, spirally alternate, spreading; leaf lamina linear, 15–30 mm long, 1–2 mm wide; upper surface green and sparsely pubescent; lower surface densely covered with white stellate hairs; margin recurved to the midrib; leaf apex rounded; sessile marginal glands present at base of lamina. Inflorescences are mostly single-flowered and axillary. Male flowers are sessile, greenish to brown; calyx 5-lobed, hairless outside. Female flowers are sessile or shortly pedicellate; calyx 5-lobed, light green; lobes equal, revolute, hairless outside, with entire margins; petals absent; ovary 3-locular, sparsely covered with stellate hairs; style initially columnar, splitting into three long spreading red branches 3–3.5 mm long. Capsules are ellipsoid, 9 mm long, 4.5 mm wide, sparsely hairy, 1-seeded, calyx lobes persistent. Seeds are ovoid, 7.5–7.7 mm long, 3.7–3.9 mm wide; caruncle pyramidal, yellowish (Fatemi 2005).

Bertya gummifera is distinguished from *Bertya* sp. Chambigne NR (M.Fatemi 24) by having densely hairy young stems and a perianth enlarging around the fruit, while *B. recurvata* has non-stellate glandular hairs on leaves and young stems; in *Bertya* sp. Chambigne NR (M.Fatemi 24) these hairs are stellate and non-glandular (Fatemi 2005).

Distribution

Bertya sp. Chambigne NR (M.Fatemi 24) is endemic to the North Coast area of New South Wales (NSW) where it is currently known to occur within the Clarence Sandstones subregion (Commonwealth DCCEEW 2024). It has five known subpopulations: Chambigne (in Chambigne Nature Reserve and the adjacent Shannon Creek Dam catchment area); Kremnos (private property); Stockyard Creek (private property); and Yuraygir North and Yuraygir South (within Yuraygir State Conservation Area).

Bertya sp. Chambigne NR (M.Fatemi 24) was first collected in 1967 (NSW 194912) on sandstone at Whiteman Creek north of Grafton, however, that subpopulation is now thought to be extinct (Fatemi *et al.* 2007). The taxon was subsequently recorded in the 1990s on vacant Crown land that is today the western portion of Chambigne Nature Reserve (NR) (J. Edwards *in litt.* September 2021) and was included in a systematic study of *Bertya* by Fatemi (2005). An outlying record near Coutts Crossing (NSW 714516) has poor location accuracy and is considered to be collected from the Chambigne subpopulation (P. Sheringham *in litt.* October 2024).

Extent of occurrence and area of occupancy

Bertya sp. Chambigne NR (M.Fatemi 24) has an estimated area of occupancy (AOO) of ~36 km², and an estimated extent of occurrence (EOO) of ~881 km². As recommended by IUCN (2024), AOO is based on 2 x 2 km grid cells, while EOO is based on a minimum convex polygon enclosing valid occurrence records for the taxon (ALA 2024; NSW Government 2024).

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Population Size

The estimated total population size for *Bertya* sp. Chambigne NR (M.Fatemi 24) is 342–1,033 mature individuals.

In the Chambigne subpopulation, a total of 1,670 *Bertya* sp. Chambigne NR (M.Fatemi 24) were recorded in a detailed census of four of the six patches of this taxon in October 2021 (P. Sheringham *in litt.* October 2021). Of these, ~153 were mature, and the remainder were seedlings that emerged after the 2019/20 fires, including a number of seedling clumps. In a less detailed survey of the remaining two patches, undertaken after the fire in 2019, a total of 55 individuals of unknown age structure were recorded. If all seedlings either died or survived to maturity, respectively, the estimated number of mature individuals in the Chambigne subpopulation would be between 153–1,725. However, seedling survival rate is not likely to be high due to a high mortality rate in seedling clumps, and further fires in 2023/24 may have adversely affected some patches of seedlings. From a review of published data, the percentage of newly emerged seedlings surviving to reproductive maturity ranged from 0.5–39.8% across 19 species from 12 families (Moles and Westoby 2004). Assuming a 0.5–40% survival rate for *Bertya* sp. Chambigne NR (M.Fatemi 24), it is estimated that there would be between 161 and 815 mature individuals in the Chambigne subpopulation, though this may be a large overestimation given that even 0.5% survival from emergence to maturity could be unrealistically high (Moles and Westoby 2004).

In 2023, a census in Yuraygir State Conservation Area recorded two subpopulations of *Bertya* sp. Chambigne NR (M.Fatemi 24), totalling 302 individuals of which 60–70% (~181–211 individuals) were mature (P. Sheringham *in litt.* August 2023). In addition, the two subpopulations on private property (Kremnos and Stockyard Creek) were reported to have a total of seven individuals of unknown age structure in 2022 (NSW Government 2024).

Ecology

Habitat

Sheringham (P. Sheringham *in litt.* October 2021) states “*Bertya* sp. Chambigne NR (M.Fatemi 24) occupies exposed north-westerly aspects usually at the top of cliff lines in rocky sites. The habitat is dominated by an open cover of trees including *Eucalyptus psammitica*, *Angophora robur*, *Corymbia trachyphloia*, *Eucalyptus pyrocarpa*. The shrub layer includes *Allocasuarina littoralis*, *Xanthorrhoea latifolia*, *Acacia complanata* and *Boronia hapalophylla*. *Eriachne pallescens* and *Entolasia stricta* are common in the ground layer.” Plants of *Bertya* sp. Chambigne NR (M.Fatemi 24) are sparsely distributed in known sites (Figure 2). The endangered *Grevillea beadleana* co-occurs with *Bertya* sp. Chambigne NR (M.Fatemi 24) on the Western Chambigne escarpment. *Bertya* sp. Chambigne NR (M.Fatemi 24) may occur in other habitats elsewhere.

Lifespan

Bertya sp. Chambigne NR (M.Fatemi 24) is a perennial shrub with an unknown lifespan. Other species of *Bertya* are long lived (20+ years, *B. ingramii*, Scott and Gross 2004) and this is suspected to be the case for *Bertya* sp. Chambigne NR

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(M.Fatemi 24). First flowering probably occurs within three years and full maturity at about five years (age of first flowering for *B. brownii* is <5 years, Ferrer-Paris and Keith 2022). Generation length is unknown but likely to be 10–20 years (C.L. Gross *in litt.* July 2025). It is not known how long an individual *Bertya* sp. Chambigne NR (M.Fatemi 24) will be fecund, but plants of *B. ingramii* thought to be more than 20 years old produce small crops of viable seed every year in a long term (60+ years) fire free environment, albeit showing signs of senescence (Scott and Gross 2004). It is not known if the seed bank of *Bertya* sp. Chambigne NR (M.Fatemi 24) is persistent (as in *B. brownii*) or transient (as in *B. findlayi*) (Ferrer-Paris and Keith 2022).

Pollination

Bertya sp. Chambigne NR (M.Fatemi 24) flowers in spring to early summer and plants have unisexual flowers with both female and male flowers occurring on the same plant (monoecious). The flowers are very similar in presentation to other species in *Bertya* that are wind pollinated (Scott and Gross 2004; Fatemi and Gross 2009). In *B. ingramii*, *B. rosmarinifolia*, and probably *Bertya* sp. Chambigne NR (M.Fatemi 24), female flowers are presented first, followed by a shorter duration of pollen-shedding male flowers (Figure 1). The distance that pollen moves among plants of *Bertya* sp. Chambigne NR (M.Fatemi 24) is unknown. However, pollen dispersal over 3 km has been detected in other species of *Bertya* (Fatemi and Gross 2009).

Seed ecology

Seeds are not held on *Bertya* sp. Chambigne NR (M.Fatemi 24) for more than a few months and are probably ballistically discharged or are shed in their mericarps as has been found in other species of *Bertya* (Scott and Gross 2004). The seed biology for *Bertya* sp. Chambigne NR (M.Fatemi 24) is unknown. Scott and Gross (2004) found that *B. ingramii* and *B. rosmarinifolia* have a dormancy mechanism. Germination was triggered by scarification treatment, suggesting physical dormancy, with best germination outcomes following scarification and hormone application, the latter suggesting physiological dormancy. Seeds did not respond to long-duration experimental heat treatments (30 min at 80°C, 100 min at 100°C, which were possibly lethal to seeds) (Scott and Gross 2004).

In two species of *Bertya*, seeds with and without the caruncle were rapidly collected by four species of ants (Scott and Gross 2004) and relocated to nests in the vicinity of the plants. The distances that the ants are capable of dispersing seeds of *Bertya* sp. Chambigne NR (M.Fatemi 24) is unknown. In *Adriana quadripartita* (Euphorbiaceae), which has very similar seeds to *Bertya* spp., seeds were moved on average c. 1.5 m and up to 5 m from the parent shrub (Beamont *et al.* 2009). This suggests that seed dispersal between patches is unlikely for *Bertya* sp. Chambigne NR (M.Fatemi 24).



Figure 2. Habitat for *Bertya* sp. Chambigne NR (M.Fatemi 24) in the eastern part of Chambigne Nature Reserve (Credit: Paul Sheringham, 3 October 2021). A shrub of this taxon is at the base of the tree on the left of the picture. This site was unburnt in the 2019/20 fire season.

Fire ecology

Bertya sp. Chambigne NR (M.Fatemi 24) is an obligate seeding taxon, whereby adult and juvenile plants are killed by fire and the taxon does not resprout from a lignotuber (NSW SC 2007). However, some *Bertya* sp. Chambigne NR (M.Fatemi 24) escaped scorch during fire events in the refugia of sandstone rocks and near cliff edges. It is inferred that the rocky part of this taxon's habitat may sometimes afford protection from fire for some individuals, as has been found for other species (Clarke 2002).

Bertya sp. Chambigne NR (M.Fatemi 24) is not dependent on fire for germination; seedlings emerge with or without a fire event. In 2004, following some years of severe drought, moderate rains stimulated a germination event, with the establishment of 200–300 seedlings up to 30 cm height as of August 2005 (J. Edwards pers. comm., August 2006 in NSW SC 2007). This suggests that some seeds either become non-dormant over time or are produced in a non-dormant state. The Chambigne (East NR) site that was not burnt in the 2019/20 fire season (but was burnt in 2015/16 and 2011/12, Table 1) had 100 adults and 143 seedlings/juveniles in October 2021 (P. Sheringham *in litt.* Oct 2021; NSW DCCEE 2024). Seedlings noted in that patch may have emerged in response to drought-breaking rain.

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Table 1. Fire history for *Bertya* sp. Chambigne NR (M.Fatemi 24) derived from the intersection or close (<100 m) proximity of occurrence records with NSW DCCEEW (2020, 2024) data from the last 50 years (the record is not comprehensive, and some geographical inaccuracy is expected).

Subpopulation (Site)	Season	Extent / Severity
Chambigne (West NR)	2002/03	Entire site
	2011/12	Nearby (within 30 m)
	2015/16	Entire site
	2020/21	Entire site / Moderate
	2023/24	Part site / Moderate
Chambigne (East NR)	2002/03	Nearby (within 100 m)
	2011/12	Entire site
	2015/16	Part site
	2023/24	Part site / Unburnt
Chambigne (East of Dam)	2014/15	Part site
	2019/20	Entire site / Low–High
	2023/24	Part site / Low–High
Kremnos	2014/15	Nearby (within 90 m)
	2019/20	Entire site / Moderate
Stockyard Creek	2017/18	Nearby (within 40 m) / Unburnt–Low
Yuraygir North	2001/02	Entire site
	2019/20	Entire site / Low–Extreme
Yuraygir South	1995/96	Nearby (within 70 m)
	2002/03	Entire site
	2017/18	Entire site / Moderate–High
	2019/20	Entire site / Unburnt–Moderate

Cultural Significance

The Gumbaynggirr and Bundjalung peoples are the Traditional Custodians of the lands on which *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs (Horton 1996). This assessment is not intended to be comprehensive of the traditional ecological knowledge that exists for *Bertya* sp. Chambigne NR (M.Fatemi 24), 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*

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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* (ICIP) protocol (Janke and Company 2023).

Threats

The primary threat to the known population of *Bertya* sp. Chambigne NR (M.Fatemi 24) is the adverse effects that frequent fires, combined with increased incidence of drought, may have on the taxon's abundance and persistence.

Adverse fire regimes and drought

High fire frequency is an inferred ongoing threat to *Bertya* sp. Chambigne NR (M.Fatemi 24) (Table 1). Seedlings and juveniles of this taxon may experience particularly high mortality if subject to severe drought or fires with an interval of five or fewer years. Short-interval fires can kill seedling/juvenile recruits before replenishment of the soil seed bank occurs, and lead to significant population declines. As fire kills *Bertya* sp. Chambigne NR (M.Fatemi 24), a fire free interval of at least 10 years would give a seedling—first flowering at around three years and reaching full maturity at around five years—a further five years to establish and develop a soil seed bank.

Parts of the Chambigne subpopulation have experienced a fire interval of five years or less on multiple occasions between 2011 and 2023 (Table 1, NSW DCCEE 2020, 2024). Yuraygir South was also burnt twice between 2017 and 2019, albeit not at high intensity in 2019, potentially due to the outcrop habitat with low ground fuel at this site (P. Sheringham *in litt.* Oct 2021) in combination with mild fire weather. Of particular concern is the Chambigne (West NR) site, which has experienced fire intervals of nine, four, five, and three years (Table 1), and has declined since the mid-1990s (P. Sheringham *in litt.* October 2021). Sheringham (*in litt.* Oct 2021) estimates there were previously ≥ 50 *Bertya* sp. Chambigne NR (M.Fatemi 24) at this site but counted only four seedlings and no mature individuals in October 2020, after the August 2020 fire.

Continuing decline in the number of mature *Bertya* sp. Chambigne NR (M.Fatemi 24) is inferred given the likely continuation of high fire frequency. Under future climate scenarios for the North Coast region, by 2050 it is projected that: 1) there will be 5.9–8.6 more days $\geq 35^{\circ}\text{C}$ per year; 2) average temperature will increase by 1.1–1.7°C; and 3) there will be a small increase (~ 0.5 days/year) in severe fire weather days per year (AdaptNSW 2024). Additionally, time spent in drought is projected, with medium confidence, to increase over the course of the century for the region where *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs (CSIRO 2024). This could limit seedling recruitment, both post-fire and during intervals between fires. 'Anthropogenic Climate Change' and 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' are listed as Key Threatening Processes under the NSW *Biodiversity Conservation Act 2016*. 'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' and 'Fire regimes that cause declines in biodiversity' are listed as Key Threatening Processes

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under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threat-defined Locations

Bertya sp. Chambigne NR (M.Fatemi 24) occurs in 4–7 threat-defined locations based on the most serious plausible threat of high frequency fire, which is inferred to contribute to continuing decline in the number of mature individuals. It is evident from fire history across the taxon's distribution (Table 1) that subpopulations (and patches of the taxon therein) are not uniformly affected by fires, but that fires can occur in multiple subpopulations in a single fire season. The minimum number of locations is based on the pattern observed in the 2019/20 fires, where four subpopulations were affected simultaneously: Kremnos, Yuraygir North, Yuraygir South, and one site in Chambigne; but Stockyard Creek and the two other sites in Chambigne were not affected.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Bertya* sp. Chambigne NR (M.Fatemi 24) has been adequate and there is enough scientific evidence to support the listing outcome.

Criterion A Population size reduction

Assessment Outcome: Data Deficient.

Justification: There are insufficient repeated surveys of *Bertya* sp. Chambigne NR (M.Fatemi 24) to suspect or project a population size reduction over a 30–60-year timeframe (*i.e.*, three generations). In 2006, the Chambigne subpopulation of *Bertya* sp. Chambigne NR (M.Fatemi 24) was estimated to contain 200–240 mature individuals (NSW SC 2007). Following the 2019 and 2021 surveys, the Chambigne subpopulation was estimated to contain 161–815 mature individuals. Interpretation of changes in population size for *Bertya* sp. Chambigne NR (M.Fatemi 24) requires caution given that it is an obligate seeder and, therefore, likely to undergo natural fluctuations in relation to time since the last fire (or other germination event).

Criterion B Geographic range

Assessment Outcome: Endangered under Criterion B1ab(v)+2ab(v)

Justification: *Bertya* sp. Chambigne NR (M.Fatemi 24) has an estimated area of occupancy of ~36 km², and an estimated extent of occurrence of ~881 km², which meet the thresholds for Endangered of <500 km² and <5,000 km², respectively.

In addition to these thresholds, at least two of three other conditions must be met.

- 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 with ≤5 locations.

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Justification: *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs in 4–7 threat-defined locations based on the most serious plausible threat of high frequency fire. The minimum number of locations is based on the pattern observed in the 2019/20 fires, where four subpopulations were affected simultaneously: Kremnos, Yuraygir North, Yuraygir South, and one site in Chambigne; but Stockyard Creek and the two other sites in Chambigne were not affected. Four locations is applied in this assessment, following the precautionary principle.

Bertya sp. Chambigne NR (M.Fatemi 24) does not meet the IUCN (2024) definition of severely fragmented as most of the mature individuals occur in Chambigne, which is considered to be a viable subpopulation.

- 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 sub-populations; (v) number of mature individuals.

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

Justification: Given the history of frequent fire where *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs (Table 1), and the likelihood of increased severe fire weather and drought (AdaptNSW 2024; CSIRO 2024), continuing decline in the number of mature individuals is inferred. For example, the Chambigne (West NR) site, where decline has been noted (P. Sheringham *in litt.* October 2021), has experienced repeated fires in 2002/03; 2011/12; 2015/16; 2020/21; and 2023/24. A longer fire interval is required to allow growth to maturity and replenishment of the soil seedbank.

- c) Extreme fluctuations.

Assessment Outcome: Not met.

Justification: *Bertya* sp. Chambigne NR (M.Fatemi 24) is not known to undergo extreme fluctuations in geographic distribution, number of locations or subpopulations, or population size. The number of individuals does fluctuate naturally in response to fire, rainfall and probably drought.

Criterion C Small population size and decline

Assessment Outcome: Vulnerable under Criterion C2a(i)

Justification: The estimated total population size for *Bertya* sp. Chambigne NR (M.Fatemi 24) is 342–1,033 mature individuals. This meets the threshold for Endangered (<2,500 mature individuals), however, the required subcriteria are only met 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

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generations (whichever is longer) (EN); or 10% in 10 years or 3 generations (whichever is longer) (VU).

Assessment Outcome: Data Deficient.

Justification: There are insufficient repeated surveys of *Bertya* sp. Chambigne NR (M.Fatemi 24) to estimate or project a population size reduction over a 20–40 year timeframe (*i.e.*, two generations). In 2006, the Chambigne subpopulation of *Bertya* sp. Chambigne NR (M.Fatemi 24) was estimated to contain 200–240 mature individuals (NSW SC 2007). Following the 2019 and 2021 surveys, the Chambigne subpopulation was estimated to contain 161–815 mature individuals. These data likely reflect the fluctuations expected in an obligate seeding species that has recently been burnt. Note that there has been a decline in the Chambigne (West NR) site (P. Sheringham *in litt.* October 2021). Further surveys are required to determine whether the 2023/24 fires in Chambigne had adverse effects on the population.

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

Assessment Outcome: Met for continuing decline.

Justification: Given the history of frequent fire where *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs (Table 1), and the likelihood of increased severe fire weather and drought (AdaptNSW 2024; CSIRO 2024), continuing decline in the number of mature individuals is inferred. For example, the Chambigne (West NR) site, where decline has been noted (P. Sheringham *in litt.* October 2021), has experienced repeated fires in 2002/03; 2011/12; 2015/16; 2020/21; and 2023/24. A longer fire interval is required to allow growth to maturity and replenishment of the soil seedbank.

In addition, at least 1 of the following 3 conditions:

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

Assessment Outcome: Met for Vulnerable

Justification: Chambigne is the largest known subpopulation of *Bertya* sp. Chambigne NR (M.Fatemi 24) and is estimated to contain 161–815 mature individuals. The majority of this estimate is above the Endangered threshold of 250, thereby meeting the threshold for Vulnerable.

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

Assessment Outcome: Not met.

Justification: Chambigne is the largest known subpopulation of *Bertya* sp. Chambigne NR (M.Fatemi 24) and is estimated to

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contain ~47–79% of mature individuals, which does not meet the threshold for Endangered or Vulnerable.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not met.

Justification: There is no evidence that the population of *Bertya* sp. Chambigne NR (M.Fatemi 24) has undergone extreme fluctuations. The number of individuals does fluctuate naturally in response to fire, rainfall and probably drought.

Criterion D Very small or restricted population

Assessment Outcome: Met for Vulnerable under Criterion D1.

Justification: Refer to D1 and D2 below.

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

Assessment Outcome: Met for Vulnerable

Justification: The estimated total population size for *Bertya* sp. Chambigne NR (M.Fatemi 24) is 342–1,033 mature individuals. The majority of this estimate falls below the threshold of 1,000.

- D2. Restricted area of occupancy (typically <20 km²) 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: Not met.

Justification: *Bertya* sp. Chambigne NR (M.Fatemi 24) has an estimated AOO of 36 km² and occupies 4–7 threat-defined locations. None of the threats to this taxon are expected to drive it to Critically Endangered, or Extinct, within a very short time.

Criterion E Quantitative analysis

Assessment Outcome: Data Deficient.

Justification: No quantitative analysis has been undertaken for *Bertya* sp. Chambigne NR (M.Fatemi 24) at this time.

Conservation and Management Actions

Bertya sp. Chambigne NR (M.Fatemi 24) is currently listed on the NSW *Biodiversity Conservation Act 2016* 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 taxon is extant in the wild in 100 years. The

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following is derived from the threat information and could be used to develop management actions.

Habitat loss, disturbance and modification

- Prevent frequent habitat disturbance in the vicinity of *Bertya* sp. Chambigne NR (M.Fatemi 24).
- Minimise adverse fire regimes. Ensure prescribed burns in the vicinity of the taxon provide a sufficient fire-free interval (minimum 10 years) to allow maturation of individuals and accumulation of a soil seed bank. During drought this minimum time between fires should be increased.

Ex situ conservation

- Develop a targeted *Bertya* sp. Chambigne NR (M.Fatemi 24) seed collection program for *ex situ* seed banking following best-practice guidelines (Martyn *et al.* 2021).
- Develop a protocol for propagation of the taxon via seeds, cuttings or tissue culture and trial the techniques on limited wild material to determine the best time of the year to source material. Consult with Botanic Gardens of Sydney (BGS) and the Australian PlantBank as to known protocols for the taxon. The work of Roberts and Trueman (2016) on *Bertya pedicellata* is informative.
- Develop techniques for population augmentation using conservation plantings into rocky habitats. Develop a species-specific translocation plan following national translocation protocols (Commander *et al.* 2018).

Stakeholders

- Liaise with managers of Chambigne NR and Yuraygir State Conservation Area for conservation management and protection of *Bertya* sp. Chambigne NR (M.Fatemi 24).
- Liaise with authorities with fire management responsibilities to ensure there is effective communication between agencies and private landowners regarding the requirement of fire-free intervals in habitat of *Bertya* sp. Chambigne NR (M.Fatemi 24).
- Update the Fire Management Strategy for Chambigne NR (NSW OEH 2014) to identify where *Bertya* sp. Chambigne NR (M.Fatemi 24) occurs and ideally implement fire-free intervals sufficient to allow juvenile plants to become fire resistant (a minimum of 10 years for seed bank replenishment).

Survey and Monitoring Priorities

- Regularly monitor the population size, structure and habitat of *Bertya* sp. Chambigne NR (M.Fatemi 24) to determine whether there is a decline in the population. Tag individuals with fire-proof tags to monitor survival over time and to determine vital statistics around longevity and time to reproduction.
- Re-survey the population following every fire and significant drought event to identify plant survival, recruitment, and signs of population decline.

Information and Research Priorities

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Recruitment and seedling survival

- Establish plots to monitor seedling recruitment.
- Once found, seedlings should be carefully tagged with fire-proof tags/labels for annual or biennial monitoring.
- Undertake research to further improve understanding of seed dormancy mechanisms and seed bank dynamics.
- Monitoring labelled plants through time will allow for a Population Viability Analysis to be built in due course that will then allow for modelling of stochastic events on population persistence.

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APPENDIX 1

Assessment against *NSW Biodiversity Conservation Regulation 2017* criteria

The Clauses used for the assessment are listed below for reference.

Overall Assessment Outcome:

Bertya sp. Chambigne NR (M.Fatemi 24) was found to be Endangered under Clause 4.3(b)(d)(e i)

Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

Assessment Outcome: 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: Endangered under Clause 4.3(b)(d)(e 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,

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		(iii)	the number of locations in which the species occur or of populations of the species.
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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)(e i,ii A(III))

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: Vulnerable under Clause 4.5(c)

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.

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**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.
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