

## Conservation Assessment for *Homoranthus bebo*

Tom D. Le Breton<sup>1</sup> and Tony D. Auld<sup>1</sup>

31<sup>st</sup> January 2018

1, Science Division, NSW Office of Environment and Heritage

### ***Homoranthus bebo* L.M. Copel. (Myrtaceae)**

Distribution: Endemic to NSW

Current EPBC Act Status: Not Listed

Current NSW TSC Act Status: Not Listed

Conservation Advice: *Homoranthus bebo*

### **Summary of Conservation Assessment**

*Homoranthus bebo* was found to be eligible for listing as Critically Endangered under Criterion B1ab(iii, v) + 2ab(iii, v). The main reasons for this species being eligible are i) that it has a highly restricted geographic distribution with both an extent of occurrence (EOO), estimated by calculating the area within the smallest possible polygon containing all known records as per IUCN Guidelines (2016), and an area of occupancy (AOO), estimated using 2 x 2 km grids as per IUCN Guidelines (2016), of 4 km<sup>2</sup>; ii) the species is known from a single location in Dthinna Dthinnawan Nature Reserve in the far North of NSW; iii) there is a projected continuing decline inferred in area, extent and/or quality of habitat and number of mature individuals as the species appears extremely sensitive to fire and observations suggest very slow rates of recruitment and recolonization of burnt patches, hampering the species ability to recover following disturbance events. The size and extent of the population is such that the entire species could be lost during a single fire event of moderate severity if it is assumed that all adult plants are killed by fire and there is no seedling recovery post-fire (as has been observed in response to a recent fire).

### **Description and Taxonomy**

*Homoranthus bebo* was first described by Copeland (2011) as follows “Decumbent *shrub*, 0.05–0.2m tall, 0.5–2m wide, producing adventitious roots on prostrate branches, glabrous. *Leaves* opposite, decussate, punctate, aromatic, 3–7mm long, 0.2–0.5mm wide, 0.5–0.8mm thick, linear, mucronate, shortly petiolate, shiny, lime-green; blade in side view straight to incurved linear; petiole 0.5–0.8mm long, slightly glaucous. *Flowering branchlets* undifferentiated, with 3–10 flowers held erect in leaf axils towards branchlet apex. *Inflorescence* a monad; peduncles 0.7–1.7mm long; bracteoles caducous, 2.0–3.5mm long, pale purple. *Hypanthium* cylindrical, 5-costate, smooth between the ribs, glabrous, 2.0–3.3mm long, pale yellow–green. *Sepals* 5, 1.0–2.2mm long, yellow, the margin entire, the apex long acuminate. *Petals* 5, yellow, broadly obovate, the apex obtuse, 0.5–1.2mm long, the margin entire. *Stamens* 10; filaments ~0.4mm long; anthers globose, basifixed, yellow-brown. *Staminodes* 10, alternating with the stamens, distinctly adnate to the adjacent antepetalous stamen. *Style* 6–9mm long, exceeding the hypanthium by 3–5mm at anthesis, minutely hirsute below the papillose stigma, yellow. *Ovary* unilocular; placenta sessile, axile-basal, bearing 8–10 ovules. *Fruit* a dry, indehiscent nut, brown. (Fig. 4C.)”

*Homoranthus bebo* is most similar to *H. melanostictus* and *H. vagans*. It can be distinguished from *H. melanostictus* by its decumbent habit which results in a dense mat rarely taller than 20 cm. *H. melanostictus* is an ascending shrub up to 50 cm tall that rarely roots at the nodes. *H. bebo* has a growth habit similar to that of *H. vagans* but can be distinguished by its shiny, lime-green leaves (dull and glaucous in *H. vagans*) and its smooth rather than tuberculate hypanthium. The reference to *H. melanostictus* occurring in New South Wales by Harden (2002) relates to *H. bebo*, whereas *H. melanostictus* is endemic to Queensland.”

## Distribution

The distribution of *Homoranthus bebo* was described by Copeland (2011) as being “Currently known from a single population in Dthinna Dthinnawan Nature Reserve (formerly Bebo State Forest), ~20 km north-north-east of Yetman, northern New South Wales (Fig. 6). Plants grow in deep sandy soils over sandstone. Associated species include *Corymbia trachyphloia*, *Angophora leiocarpa*, *Eucalyptus crebra*, *Callitris endlicheri*, *Acacia leiocalyx*, *Acacia conferta*, *Aristida caput-medusae* and *Entolasia stricta*.”

Recent surveys have revealed that the population at Dthinna Dthinnawan consists of two large patches both of which appear to have experienced recent losses during hazard reduction burns and a third possible patch which may recently have been lost more or less entirely during the same burns (Hunter 2016).

The sole population of *Homoranthus bebo* occurs on reserved land in Dthinna Dthinawan Nature Reserve. The population is also classed as a single location as a single fire or other disturbance event could impact all known individuals. The species may qualify as severely fragmented if it is found that this patch size is too small to support a viable population, however, at this time there is insufficient information to assess whether this is the case or not.

The current known distribution of the species is very highly restricted with an extent of occurrence (EOO) of less than 4 km<sup>2</sup> and an area of occupancy (AOO) of 4 km<sup>2</sup>, based on a minimum convex polygon fitted to known records and 2 x 2 km<sup>2</sup> grids respectively as per IUCN guidelines (2016). The area of habitat that the species currently is known to occupy is some 9 Ha based on detailed maps (J. Hunter, pers. comm. Dec. 2016). Under the most optimistic scenario in which all nearby areas of suitable habitat turn out to be occupied by the species, the distribution of *H. bebo* would still be very highly restricted with an EOO of 60 km<sup>2</sup> (EOO was estimated as 31 km<sup>2</sup> however IUCN guidelines [2016] state EOO cannot be less than AOO and in this optimistic scenario, AOO would be 60 km<sup>2</sup>). The upper values for both EOO and AOO were calculated as per IUCN guidelines (2016) based on polygons of potential suitable habitat.

## Ecology

Population estimates of *Homoranthus bebo* are difficult to ascertain as the species is prostrate and may grow from rooting at the nodes (as occurs in other *Homoranthus* and *Darwinia* species, Briggs 1962, Copeland et al. 2011). Following the recent surveys Hunter (2016) wrote that “In dense areas of *Homoranthus bebo* it was difficult to separate individuals. Within the field different procedures were tested. A method that entailed counting potential operation units that may have constituted a non-connected clump was counted within a 10 x 10 m plot was chosen as a useful method. The survey period did not allow the required time to complete an accurate assessment of potential population size, however, based on the trial 10 x 10 m plots and counts carried out over a total of 0.16 ha it could be estimated that approximately 13,000 operation non-connected clumps may exist. This number is highly speculative and will require verification, thus we suggest that an initial range of between 10,000-20,000 clumps of *Homoranthus bebo* may exist within the mapped zones ...”

The life history of *H. bebo* is not well documented but other species of *Homoranthus* are known to be killed by fire (obligate seeders) which regenerate post-fire from persistent soil stored seed banks (Fire Ecology Unit OEH 2010), although the species may also resprout in response to low intensity fires (Hunter 2008) or where there is not 100% leaf scorch. All five species of *Homoranthus* listed in the NSW Flora Fire Response Database (Fire Ecology Unit OEH 2010) are considered to be sensitive to fire regimes with high frequency fires. Factors that govern recruitment after fire in

*Homoranthus* are unknown, although fire cues such as heat shock (which promotes germination in the closely related *Darwinia* species (Auld & Ooi 2009) and smoke, along with temperature and rainfall are likely to be important.

*Homoranthus bebo* has been observed to recruit vegetatively by rooting at nodes along all branches. Field observations suggest this is the primary method of reproduction, as during multiple surveys of the area, no *H. bebo* seedlings have ever been observed (J. Hunter, pers. comm., Jan. 2017). The species, therefore, appears to favour clonal propagation over propagating from seed. Seed germination may be triggered by a disturbance factor, but this has not been observed. The species does appear to be able to produce flowers and fruit, however, the viability of the seed is uncertain (J. Hunter, pers. comm., Jan. 2017).

It has also been suggested that vegetative reproduction may be the primary mode through which the species recolonises burnt areas (Hunter 2016). This could explain the observation that suitable habitat adjacent to the known population that had been burnt (one area burnt during a hazard reduction burn in September, 2013, another area during a wildfire, likely, in 1983) were either entirely unoccupied by the species or contained only a few scattered individuals, while areas with no evidence of fire contained the highest densities of *H. bebo*. Based on this, Hunter (2016) suggests the species may be highly sensitive to fire. There is some uncertainty about the exact fire history of the area, due to limited fire records from the period the Reserve was managed by State Forests, and it is possible more fires (HR burns or wildfires) may have occurred in the last 30 years (M. Lieberman, pers. comm. March, 2017).

The species has been associated with the Smooth-barked Apple – Black Cypress Woodland community (Copeland *et al.* 2011; Hunter 2016), which covers 5237 ha (17.8%) of the reserve (Hunter 2008). A vegetation survey of Dthina Dthinnawan NR was carried out in 2006 (Hunter 2008) which consisted of 118 floristic survey sites across the Reserve, 23 of which were in Smooth-barked Apple – Black Cypress Woodland. While these surveys were not targeted or extensive, *Homoranthus bebo* was only recorded in a small area along the northern boundary of the Reserve (see maps in Hunter 2016 attached). More extensive surveys undertaken in 2016 to map out the extent of the known *H. bebo* population, included a search of an area of 22 ha of potential habitat in which no individuals were found. This area amounts to less than 1% of the potentially suitable Smooth-barked Apple Black Cypress Woodland habitat in the reserve and it is possible further patches or sub-populations may be located by searching nearby areas of this vegetation community.

There are no observations relating to dispersal ability, however, in closely related species of *Darwinia* the indehiscent fruit is the diaspore and when fruits fall to the ground are dispersed by ants (myrmecochory) (Auld 2009). This dispersal method is short distance with seeds tending not to move more than a few metres from the parent plant.

The population structure is unknown although most individuals appear to be a result of vegetative reproduction. Similarly, generation length is unknown as is susceptibility to fragmentation.

### **Threats**

Clearing has resulted in declines for the species in the past; “this species is abundant along the far northern boundary of the reserve up to the fence line, wholesale clearing has occurred up to the fence outside of the reserve it is highly likely that the population has been reduced in numbers significantly due to past clearing activities” (Hunter, 2008). And there is evidence that the species had experienced some level of disturbance from feral pigs, *Sus scrofa* (Hunter 2008).

There are a number of current threats facing the *Homoranthus bebo* population, including disturbance/grazing from livestock entering from neighbouring properties, feral goats (*Capra hircus*), pigs (*Sus scrofa*) and rabbits (*Oryctolagus cuniculus*) (OEH 2014). There are also a number of weeds recorded in the park which may threaten *H. bebo* through competition including Coolatai grass (*Hyparrhenia hirta*), mother-of-millions (*Bryophyllum delagoense*), cat's claw creeper (*Dolichandra unguis-cati*), various prickly pear species (*Opuntia* spp.) and whisky grass (*Andropogon virginicus*) (OEH 2014).

Possibly the most significant threat facing the species right now is related to the fire regime. Hunter (2016) noted that "It was apparent during the survey that fire was the major limiting factor to population extent. In many instances the limits of the current distribution were clearly associated with recent and past fires". He also noted that there appeared to be a correlation between time since last fire and plant density with density increasing with time since last fire, and that no recruitment was observed during his surveys despite the fact that hazard reduction burns had been conducted in the area three years earlier.

Based on Hunter's (2016) observations in previously burnt areas, it appears that the ability to recruit new individuals after a fire is a critical factor in the presence or absence of *H. bebo*. Any lack of observed successful recruitment after fire may be related to:

- i) Components of the fire regime that the species experiences, including
  - a. Frequency. Should any patches have been burnt too frequently this would eliminate recruits;
  - b. Severity. The heat pulse during the passage of fires needs to be sufficient to promote seed germination; or
  - c. Seasonality. Germination may be limited to certain seasons and fire in other seasons may not promote germination.
- ii) Post-fire recruitment factors such as available rainfall (promoting germination), grazing impacts (may result in the loss of all seedlings); and
- iii) The life history of the species, including whether *H. bebo* produces viable seeds.

Currently there is insufficient understanding of the species fire ecology and reproductive ecology to elucidate the reason fire appears to be causing declines for the *H. bebo*.

A single hazard reduction burn, in September, 2013, reduced the area of the known populations of *H. bebo* by up to 34.25% (from 0.4543 km<sup>2</sup> to 0.2987 km<sup>2</sup>) based on recent surveys (Hunter 2016, J. Hunter pers. comm. Jan. 2017). Plant densities pre-fire in the burnt area observed during earlier surveys in 2006 (Hunter 2008) were comparable to those in the unburnt area (J. Hunter, pers. comm. Jan. 2017), while post-fire densities were zero as no plants remained in the burnt area. Therefore, based on Hunter's (2016) population estimate of 10,000-20,000 individual clumps in the unburnt area, between 5,000 and 10,000 clumps may have been lost after a fire, representing a 33% decline in population size. While this number is somewhat speculative, it is clear the species has suffered the loss of a significant portion of the extant population and recovery appears to be slow, with Hunter (2016) observing no recruitment three years after the most recent fire. While recruitment from the seedbank may occur at a later time dependant on some seasonal or environmental conditions which have yet to occur, the slow pace at which it occurs combined with a primary juvenile period of possibly three years (Hunter 2008), make *H. bebo* likely vulnerable to frequent fires.

The entire population also occurs within a few hundred metres of a fenceline which also runs along an access trail; maintenance activities on either the fence or the road may result in the loss of some mature individuals.

Inappropriate fire regimes are likely to remain a significant threat even if hazard reduction burns are ceased in the area where the species occurs. The size and extent of the population is such that the entire species could be lost during a single fire event of moderate severity if post-fire recruitment from the seedbank does not successfully occur.

The gazettal of Bebo State Forest as Dthinna Dthinnawan Nature Reserve has more or less eliminated the threat of clearing for alternative land use and may help to secure the species long term survival.

Grazing by livestock and feral animals will continue to pose a threat as long as they are present in the reserve. The impacts of grazing may compound the effect of other threats such as fire, e.g. where grazing eliminates post-fire seedlings before they can become established and so inhibits recruitment.

Invasive weeds may also compound the effects of other threats, either via altering the fire regime or outcompeting seedlings when they do germinate.

### Assessment against IUCN Red List criteria

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

#### *Criterion A* Population Size reduction

Assessment Outcome: Data Deficient

Justification: After fires in 2013, living plants of *H. bebo* were detectable in about 67% of the habitat that they were observed to occupy before the fire. However, generation length is unknown and although recruitment is yet to be observed following the HR burns it may still occur at a later time, therefore it is unclear whether the observed decline is a net loss for the species.

#### *Criterion B* Geographic range

Assessment Outcome: Critically Endangered via B1ab(iii, v) + 2ab(iii, v)

Justification: *Homoranthus bebo* has a very highly restricted distribution with both the current extent of occurrence (EOO) (4 km<sup>2</sup>), and area of occupancy (AOO) (4 km<sup>2</sup>), estimated using a 2 x 2 km grid, falling below the thresholds for Critically Endangered (< 100 km<sup>2</sup> and < 10 km<sup>2</sup> respectively). An upper estimate based on an optimistic scenario, in which *H. bebo* occupies all available suitable habitat in the reserve gives an EOO of 31 km<sup>2</sup> which is adjusted to match the AOO of 60 km<sup>2</sup> as EOO cannot be less than AOO according to IUCN Guidelines (IUCN 2016). For EOO, this is below the EOO threshold for Critically Endangered (< 500 km<sup>2</sup>). For AOO, it would meet the threshold for Endangered.

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

- a) The population or habitat is observed or inferred to be severely fragmented or there is only one location.

Assessment Outcome: Sub criterion met at Critically Endangered threshold.

Justification: *Homoranthus bebo* is known from only a single location in the North of Dthinna Dthinnawan Nature Reserve. The area over which the population occurs is less than 4 km<sup>2</sup> and as such the entire above ground population may be lost during a single fire event of moderate severity, if it is assumed that all adult plants are killed by fire and there is no successful seedling recovery post-fire (as appears to be the response to a recent fire).

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

Assessment Outcome: Sub criterion met

Justification: A projected continuing decline is inferred in (iii) area, extent and/or quality of habitat and (v) number of mature individuals. The species appears extremely sensitive to fire, based on Hunter's (2016) report on the species and observations suggest very slow rates of recruitment and recolonization of burnt patches, hampering the species ability to recover following disturbance events such as fire. The size and extent of the population is such that the entire species could be lost during a single fire event of moderate severity, if it is assumed that all adult plants are killed by fire and there is no seedling recovery post-fire (as has been observed in response to a recent fire).

- c) Extreme fluctuations.

Assessment Outcome: Data Deficient.

Justification: There is insufficient evidence to conclude whether the species experiences extreme fluctuations.

*Criterion C Small population size and decline*

Assessment Outcome: Least Concern under Criterion C

Justification: Population estimates are difficult for *H. bebo* due to high levels of vegetative reproduction and the clumping, mat-like habit of plants. However, estimates made during targeted surveys place the population size between 10,000 and 20,000 individual “clumps”, above the threshold for Vulnerable (<10,000). Due to this *H. bebo* does not qualify as threatened under this criterion.

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

C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future).

Assessment Outcome: Data Deficient.

Justification: While there is a projected continuing decline for the species, there is insufficient data to quantify this decline.

C2. An observed, estimated, projected or inferred continuing decline

Assessment Outcome: sub criterion met.

Justification: A projected continuing decline is inferred in area, extent and/or quality of habitat and number of mature individuals. The species appears extremely sensitive to fire, based on Hunter’s (2016) report on the species and observations suggest very slow rates of recruitment and recolonization of burnt patches, hampering the species ability to recover following disturbance events. The size and extent of the population is such that the entire species could be lost during a single fire event of moderate severity.

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

a (i). Number of mature individuals in each subpopulation <1000

Assessment Outcome: Sub criterion not met.

Justification: There is a single population consisting of >10,000 mature individuals.

a (ii). % of mature individuals in one subpopulation = 90-100%

Assessment Outcome: Sub criterion met.

Justification: There is only a single population containing all known individuals.

b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Data Deficient

Justification: There is insufficient evidence to conclude whether the species experiences extreme fluctuations.

*Criterion D Very small or restricted population*

Assessment Outcome: Vulnerable under Criterion D2

Justification: *Homoranthus bebo* is known from a single location with an AOO of 4km<sup>2</sup> this places it below the thresholds for Vulnerable under criteria D2 (AOO <20 km<sup>2</sup> or number of locations <5). Furthermore, the small size and extent of the population, coupled with its sensitivity to fire, means that the entire species could plausibly be lost during a single fire event of moderate severity, driving the species to extinction in a very short period of time.

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

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

Assessment Outcome: Least Concern

Justification: The population is estimated to be >10,000 mature individuals.

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

Assessment Outcome: Vulnerable

Justification: *H. bebo* occurs at a single location with an AOO of 4 km<sup>2</sup>.

*Criterion E Quantitative Analysis*

Assessment Outcome: Data Deficient.

Justification: There is insufficient data to quantify extinction risk.

## References

- Auld, T. D. 2009. Petals may act as a reward: myrmecochory in shrubby *Darwinia* species of south-eastern Australia. *Austral Ecology* 34, 351-356.
- Auld, T.D. and Ooi, M.K.J. (2009) Heat increases germination of water-permeable seeds of obligate-seeding *Darwinia* species (Myrtaceae). *Plant Ecology* 200, 117-127.
- Briggs, B.G. (1962) The New South Wales species of *Darwinia*. *Contributions from the NSW National Herbarium* 3, 129-150.
- Copeland, L. M., Craven, L. A., Bruhl, J. J., 2011. A taxonomic review of *Homoranthus* (Myrtaceae: Chamelaucieae). *Australian Systematic Botany* 24, 351-374. DOI: 10.1071/SB11015
- Fire Ecology Unit OEH, 2010. NSW Flora Fire Response Database. OEH (NSW), Hurstville, NSW 1481.
- Hunter, J.T., 2008. Vegetation and flora of Dthinna Dthinnawan Nature Reserve. ResearchGate. DOI: 10.13140/RG.2.1.4540.2723
- Hunter, J.T., 2016. Mapping of *Homoranthus bebo* LM Copel. ResearchGate. DOI: 10.13140/RG.2.2.26016.17922
- IUCN, 2012. IUCN Red List Categories and Criteria: Version 3.1, 2nd ed. Gland, Switzerland and Cambridge, UK.
- IUCN Standards and Petitions Subcommittee (2016) Guidelines for Using the IUCN Red List Categories and Criteria. Version 12. Prepared by the Standards and Petitions Subcommittee. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- OEH NPWS, 2014. Statement of Management Intent: Dthinna Dthinnawan Nature Reserve and Dthinna Dthinnawan National Park. OEH (NSW), Goulburn Street, Sydney, NSW 1232.

## Expert Communications

Hunter, John T., Department of Geography and Planning, University of New England, Armidale, NSW.

Copeland, Lachlan M., Eco Logical Australia Pty Ltd, Coffs Harbour, NSW.

Lieberman, Michael, NSW National Parks and Wildlife Service, Tenterfield, NSW.