

# NSW Threatened Species Scientific Committee

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## Conservation Assessment of *Xylosma parvifolia* Jessup 1984 (Salicaceae)

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NSW Threatened Species Scientific Committee

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### *Xylosma parvifolia* Jessup 1984 (Salicaceae)

*Distribution:* Endemic to Lord Howe Island, New South Wales (NSW)

*Current EPBC Act Status:* Endangered

*Current NSW BC Act Status:* Endangered

*Proposed listing on NSW BC Act:* Critically Endangered

Reason for change: Genuine change in extinction risk – increasing threat of habitat decline due to weed invasion and increasing hydrological deficit as a result of climate change.

Review of status under the NSW *Biodiversity Conservation Act 2016* (BC Act) was also required as the current Endangered status was assigned under previous NSW legislation (*Threatened Species Conservation Act 1995*) when the highest threat category available at the time of listing (2002) was Endangered.

### Summary of Assessment

*Xylosma parvifolia* was found to be eligible for listing as Critically Endangered under B1ab(iii,v) and B2ab(iii,v).

The main reasons for this listing are: 1) it has a very highly restricted geographic range (EOO 8 km<sup>2</sup>); 2) the total number of mature individuals is extremely low; 3) it is found at only a single location in the Southern Mountains region of Lord Howe Island; and 4) there is inferred continuing decline in habitat quality as a consequence of increased hydrological deficit driven by climate change, ongoing weed invasion, and changes in community structure and disturbance regimes.

### Description and Taxonomy

*Xylosma parvifolia* was first described by Jessup (1984). *Xylosma* is in the family Salicaceae. PlantNET (2023) describes *X. parvifolia* as a:

“Shrub to 2 m high, branchlets and petioles minutely puberulous. Leaves ovate-elliptical, lamina 0.4–1.2 (–3) cm long, 0.4–0.8 (–1.5) cm broad, serrate; apex obtuse; petiole reddish brown, 2–3 mm long. Inflorescence to 3 (–5)-flowered; flowers solitary or in short racemes. Sepals 5, obovate, c. 1 mm long, glabrous. Male flowers with c. 12 stamens; filaments 2–2.5 mm long. Female flowers with ovoid-globose ovary, 2 mm long; styles 2, very short. Fruit ovoid-globose, 3 mm long, slightly fleshy, purple.”

### Distribution and Abundance

*Xylosma parvifolia* is endemic to Lord Howe Island (NSW Government Office of Environment and Heritage, 2016; NSW Flora Online (PlantNet, accessed May 2023). Lord Howe Island (31.54°S, 159.08°E) is the largest of a collection of small subtropical volcanic islands in the Tasman Sea, 760 km northeast of Sydney (Department of Environment and Climate Change (NSW), 2007). The island is around 11 km long,

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and only 2.8 km at its widest point, with a total area of 1,455 hectares and a maximum elevation of 875 m on its highest peak, Mt Gower (Department of Environment and Climate Change (NSW), 2007). The Lord Howe Island group was colonised by lineages of flora and fauna from mainland Australia, New Zealand, and New Caledonia, and this diversity of origins combined with the island group's isolation has led to the evolution and development of a high number of endemic species and unique ecosystems (Auld & Leishman, 2015). There is a small town on the main island, however development and tourism are strictly controlled; 75% of the main island and all other islands in the Lord Howe Island group are conservation protected, and the island group is UNESCO World Heritage listed (Department of Environment and Climate Change (NSW), 2007).

*Xylosma parvifolia* is restricted to the Southern Mountains region of Lord Howe Island, encompassing Mount Lidgbird (31.56°S, 159.08°E; 777 m elevation) and Mount Gower (31.59°S, 159.074°E; 875 m elevation) (NSW Government Office of Environment and Heritage, 2016). *Xylosma parvifolia* is restricted to narrow, exposed south-westerly and south-easterly ridges above 400m elevation, generally occurring as single plants or in small patches (NSW Government Office of Environment and Heritage, 2016). The maximum distance between Mount Gower and Mount Lidgbird sites is around 2 km (C. Stehn pers. comm. June 2022).

Much of the habitat of the species is challenging to access, requiring difficult hikes or rock climbing, and some known sites are almost entirely inaccessible, made even more challenging following landslips in 2020 (Hutton, 2005; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; Sheringham et al., 2020). As a consequence, monitoring sites are restricted to the few areas regularly accessible by foot, however likely habitat has been well documented and range and population estimates are likely to be reliable (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; Sheringham et al., 2020).

## Population Estimates

Experts estimate a total population of 200 plants based on surveys from 2017 to 2021, including both mature and juvenile individuals (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; C. Stehn pers. comm. October 2022). Of these, a minimum of 90% are estimated to be mature (C. Stehn pers. comm. October 2022). While individuals likely to be saplings and juveniles have been observed, the stunted nature of some communities can make estimation of age and maturity difficult (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c). Based on these figures the mature population is estimated to be 180-200 individuals.

Ongoing monitoring is undertaken in seven plots ranging from 5 x 5m to 15 x 15m (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c). Results are then extrapolated across the area over which *Xylosma parvifolia* is believed to occur, to produce a total population estimate (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c). Selection of sites for ongoing monitoring is primarily determined by accessibility, but sites are considered to provide a reliable representation of the broader population (Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c). Landslips in 2020/21 resulted in several sites becoming

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inaccessible, however despite ongoing challenges in access to some monitoring sites, surveys are still considered to provide an appropriate sample to produce population estimates (C. Stehn, pers. comm. April 2023).

Since 2017, the sites have been formally monitored every two years, and individuals are opportunistically monitored both inside and outside monitoring sites when possible (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; C. Stehn pers. comm. October 2022). All individuals in monitoring plots are counted and measurements of population structure are recorded (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c).

Surveys conducted for *Xylosma parvifolia* prior to 2017 were not systematic and were conducted at a subset of the sites (NSW Government Office of Environment and Heritage, 2016). These surveys expanded the known sites for *X. parvifolia* but did not provide estimates of population, and therefore have not been used to estimate population trend for the species.

## Extent of Occurrence and Area of Occupancy

Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated based on occurrence records drawn from BioNet and recent monitoring reports (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; C. Stehn pers. comm. October 2022; NSW Office of Environment and Heritage, 2022). This yielded 34 records, describing different clusters of very closely grouped plants at two sites on Mount Lidgbird and Mount Gower.

EOO and AOO were estimated in Geocat (Bachman et al., 2011). Area of Occupancy (AOO) was calculated by overlaying 2 km x 2 km grid cells over the known occurrence and is the spatial scale of assessment recommended by IUCN (2022). Extent of Occurrence (EOO) is based on a minimum convex polygon enclosing all known occurrences of the species recorded in Bionet, the method of assessment recommended by IUCN (2022).

AOO for *Xylosma parvifolia* is 8 km<sup>2</sup>. Surveys since 2001 have detected *X. parvifolia* at a small number of sites confined to the Southern Mountains area of Lord Howe Island (NSW Government Office of Environment and Heritage, 2016). As a consequence, the entire population of *X. parvifolia* occurs in an area that can be contained within two (2) 2 km x 2 km grid squares, which is the smallest standard grid resolution recommended for assessments of AOO under the IUCN Guidelines (IUCN Standards and Petitions Committee 2022).

*Xylosma parvifolia* is restricted to small lengths of narrow ridgeline on Mount Gower and Mount Lidgbird, and as a result EOO (0.668 km<sup>2</sup>) is less than or equal to estimates of AOO (8 km<sup>2</sup>). Where EOO is less than or equal to AOO IUCN Guidelines recommend EOO estimates be changed to be equal to AOO to ensure consistency with the definition of AOO as an area that fits within EOO (IUCN Standards and Petitions Committee, 2022). As such, the EOO for *X. parvifolia* is also 8 km<sup>2</sup>.

Consistent and ongoing vegetation surveys across Lord Howe Island mean these estimates of EOO and AOO are likely to accurately reflect distribution of *Xylosma*

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*parvifolia* across Lord Howe Island and are appropriate for assessment under the IUCN (2022) criteria.

## Ecology

*Xylosma parvifolia* is restricted to narrow, exposed, south-westerly or south-easterly cliff faces and ridges on Mount Gower and Mount Lidgbird (NSW Government Office of Environment and Heritage, 2016). *Xylosma parvifolia* occurs in open, exposed sites with minimal canopy cover, and does not tolerate competition (NSW Government Office of Environment and Heritage, 2016; C. Stehn pers. comm. June 2022). The species shares general habitat and ecological niche with three other threatened plant species, *Carmichaelia exsul*, *Geniostoma huttonii* and *Coprosma inopinata*, along with more common species (Hutton, 2001, 2005; NSW Government Office of Environment and Heritage, 2016).

## Reproduction, Dispersal, and Failure to Colonise

Little is known about mechanisms of reproduction and dispersal in *Xylosma parvifolia*. *Xylosma* species are typically dioecious (producing male and female flowers on separate plants), and this is almost certainly also true of *X. parvifolia* (Chase & Gardens, 2002; H. Sleumer, 1974). *Xylosma parvifolia* flowers between December and May, producing small, white flowers (NSW Government Office of Environment and Heritage, 2016). The genus *Xylosma* contains both wind pollinated and insect pollinated species, but it is not known which system is employed by *X. parvifolia* (Pfeiffer, 2018; Weber, 2008). *Xylosma parvifolia* produces small, purple fruits, likely to be attractive to birds.

During two decades of monitoring, *Xylosma parvifolia* has not been observed to colonise adjacent habitat, and while it persists well at sites where it is already established it appears to struggle to compete with other endemic or invasive species (C. Stehn pers. comm. October 2022). Cliff-dwelling species like *X. parvifolia* are commonly specialised to grow in harsh, exposed conditions, allowing plants to thrive on cliff faces and ridgelines (Caperta *et al.*, 2014). However, rare and highly specialized species may also be less tolerant to changes in habitat or climate, which may reduce their competitiveness with invasive and endemic generalist species under sub-optimal conditions (Caperta *et al.*, 2014; Elizabeth, 2007).

## Threats

### *Increasing hydrological deficit as a result of climate change*

While there is broad uncertainty in the projected range and severity of climate impacts on Lord Howe Island, Auld and Leishman (2015) determined that there was evidence for increase in temperature and a decrease in overall rainfall on Lord Howe Island over the last 50 years, stating that:

“...sea level temperatures around Lord Howe Island have risen by some 0.6°C since 1940... average annual air temperature on Lord Howe Island is expected to rise (compared with 1990 levels) by  $1.3 \pm 0.6^\circ\text{C}$  by 2030, although there is much uncertainty around such estimates... For annual rainfall, we found over the last 50 years there had been a decline of 31% (95% CL 4–79%)... Both minimum and maximum temperatures at sea level increased in the last 50 years...”

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The majority of plants endemic to the Lord Howe group are reliant on high humidity and are threatened by an increasingly dry environment (Auld & Leishman, 2015). A less humid environment will likely favour less specialised invasive weed species and reduce suitable habitat available to native species like *Xylosma parvifolia* (Auld & Leishman, 2015). 'Anthropogenic climate change' is listed as a Key Threatening Process under the NSW Biodiversity Conservation Act (BC Act).

Cloud lift and resulting habitat loss is another effect of climate change that poses a direct threat to *Xylosma parvifolia*. Clouds form when air cools to dew point as a parcel of air rises vertically via convection, front and orographic (mountain) uplift, and many plants on Lord Howe Island depend on consistent and ongoing formation of cloud to provide the high humidity and moisture on which they depend (Auld and Leishman 2015). An increase in sea temperatures is likely to increase the altitude at which clouds form, increasing aridity at lower altitudes and pushing dependent species further towards the summit, and is dubbed the 'lift-cloud-base hypothesis' (Auld and Leishman 2015).

Cloud forests serve as a 'bucket', absorbing rain and atmospheric moisture at the summit which then flows downhill, providing available moisture for plant communities further downslope (Foster 2001), including *Xylosma parvifolia* habitat. Loss of cloud poses a direct threat to species that live in cloud forest at the summits of Mount Gower and Mount Lidgbird, as well as species such as *X. parvifolia* that are found below the cloud line and receive moisture created by cloud formation at the summit. Ongoing increase in sea surface temperature, and associated cloud loss and increasing vapour deficits are therefore likely to reduce the quality and availability of habitat for *X. parvifolia* in the future.

*Xylosma parvifolia* is confined to cliffs and ridges at relatively high elevations (~400-600 m), above which habitat is generally unsuitable, largely opening into plateaux dominated by dense vegetation, especially Gnarled Mossy Cloud Forest. (C. Stehn pers. comm. June 2022). The general lack of adjacent exposed cliffs and ridgelines at higher elevations means that there is limited accessible habitat into which *X. parvifolia* can disperse as increasing aridity makes current habitat less suitable (C. Stehn pers. comm. June 2022). As a poor coloniser, *X. parvifolia* is likely to struggle to expand into any new habitat that may become available as aridity forces resident plant communities to higher elevations. Even if resident plant communities are pushed from habitat potentially suitable for *X. parvifolia*, components of these communities, like established trees or generalist weed species, are likely to persist and present an ongoing barrier to colonisation.

The severe drought from 2018 to 2021 demonstrably impacted multiple Lord Howe Island plant species and communities and showed that drought is a severe and ongoing threat for species on Lord Howe Island (International Union for Conservation of Nature and Natural Resources 2020; NSW Government Saving our Species 2021b). Droughts across the Australian continent are becoming more severe as background climate becomes more arid (Abram et al. 2021), and where this also affects offshore islands it is likely to increase the threat drought poses to endemic Lord Howe Island species, including *Xylosma parvifolia*.

## Competition by Invasive Weeds

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Invasive weeds pose a severe and ongoing threat to *Xylosma parvifolia* (Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2016). Weeds encroach on the habitat of *X. parvifolia*, outcompeting existing plants for resources and space and inhibiting recruitment by reducing the likelihood *X. parvifolia* seeds will find sufficient space and resources to germinate (Lord Howe Island Board, 2016; T. Auld pers. comm. 2022). Of particular concern are *Ageratina adenophora* (Crofton weed), *Lilium formosanum* (Formosan lily), *Cenchrus clandestinus* (Kikuyu grass), *Asparagus aethiopicus* (ground asparagus) and *Psidium cattleianum* var. *cattleianum* (cherry guava) (Lord Howe Island Board, 2016; T. Auld pers. comm. 2022). These weed species remain common across Lord Howe Island and threaten multiple endemic plants and communities, including *X. parvifolia* (Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021c; T. Auld pers. comm. May 2022).

An ongoing intensive weed control program started in 2004 and has resulted in a decline in the number of mature weeds encroaching on habitat of *Xylosma parvifolia* (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021c). There has been a 90% reduction in mature weed plants on Lord Howe Island since weed control efforts began, and in 2020/21 only 0.01% of weeds removed in the Southern Mountains region were mature (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021c). However, there is evidence that the overall number of juvenile weeds may be increasing. In 2020/21, 63 weeds were controlled per hectare, compared to 43 per hectare in 2019/20 (NSW Government Saving our Species, 2021c). This increase is likely driven by removal of rats (discussed below), as well as drought and increasing aridity that may favour generalist weed species on Lord Howe Island (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021c). The increase in juvenile weeds highlights the severe ongoing threat of weed infestation and ecosystem decline in the absence of effective control.

## *Increased weed pressure in the absence of rodents*

Introduced rodents, in particular the ship rat (*Rattus rattus*) and house mouse (*Mus musculus*), have had a devastating effect on native flora and fauna of Lord Howe Island. Rats eat seeds and seedlings of many species and since their introduction following a shipwreck in 1918, ship rats have been the driving factor in the extinction of at least two Lord Howe Island plant species (Department of Environment and Climate Change (NSW), 2007).

An extensive Rodent Eradication Program on the main island began in 2019 (Harper et al., 2020). No mice have been detected since the completion of the island-wide baiting program (H. Bower pers. comm. 2022). Rats were detected in the settlement in 2021 (O'Dwyer et al., 2022), which triggered an intensive four-month eradication response that concluded in August 2021 (H. Bower pers. comm. February 2022). This program appears to have been successful and no evidence of rodents (rats and mice) has been detected since (H. Bower pers. comm. February 2022). Intensive ongoing monitoring and biosecurity measures are in place.

Historically rodents were not considered a severe direct threat to *Xylosma parviflora* because of its generally inaccessible habitat, although browsing and fruit predation has been observed (Lord Howe Island Board 2017; C. Stehn pers. comm. October 2022). However, it appears that rodent control has inadvertently removed predation

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pressures from weed populations as well as from native vegetation. In the absence of rodents, weed populations are increasing and spreading, posing a more significant threat to *X. parviflora* (NSW Government Saving our Species, 2021; C. Stehn pers. comm. October 2022).

*Decline in habitat quality and mature population as a consequence of changes in disturbance regimes and recruitment.*

There is inferred decline in quality of habitat as a consequence of changes in disturbance regimes, exclusion by weeds, and ongoing shifts in community structure, resulting in a decline in recruitment and mature individuals. The long history of invasive species and ecosystem decline on Lord Howe Island prior to conservation efforts means that little is known about the historic disturbance regimes under which *Xylosma parvifolia* evolved, and the patterns of ecosystem progression and dispersal and by which *X. parvifolia* maintained populations and spread to new habitat. However, the apparent lack of new colonisation by *X. parvifolia* and a decline in mature individuals strongly suggests that there has been a shift in the patterns of disturbance and dispersal upon which *X. parvifolia* was dependant.

*Xylosma parvifolia* no longer appears to colonise new sites, likely driven by an inability to compete with invasive weeds, and possible changes in habitat as a result of climate change (Department of Environment and Climate Change (Department of Environment and Climate Change (NSW), 2007; Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2017, 2019, 2020, 2021; Stehn pers. comm. 2022). Over two decades of monitoring *X. parvifolia* has not been observed to colonise any new habitat, either in apparently suitable adjacent habitat, or in newly disturbed areas following landslips (Change (Department of Environment and Climate Change (NSW), 2007; Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2017, 2019, 2020, 2021; Stehn pers. comm. 2022). As a consequence of this apparent inability to colonise new habitat, *X. parvifolia* is confined to the sites in which it is currently established, the habitat quality of which is in decline.

*Xylosma parvifolia* is not competitive in undisturbed vegetation and appears dependant on disturbance to provide new suitable habitat before being displaced by other species as this habitat succeeds to a climax community (C. Stehn pers. comm. 2022). Herbivory by feral goats (*Capra hircus*) may previously have provided ongoing disturbance at the sites at which *X. parvifolia* is present, particularly at the 'goat house' site, keeping the community very stunted, reducing competition between plants, and preventing ecological progression from disturbed habitat to climax communities, allowing *X. parvifolia* to remain at these sites (C. Stehn pers. comm. 2022). However, following the removal of goats, these communities have again slowly begun to progress, reducing the quality of habitat and increasing competition with *X. parvifolia*, ultimately resulting in the loss of mature individuals (NSW Government Saving our Species, 2021; C. Stehn pers. comm. 2022)

Three mature plants were lost from a single monitoring plot between 2016/17 and 2020/21, a decline inferred to be a result of crowding and competition with other plant species (Department of Environment and Climate Change (NSW), 2007; Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2017, 2019, 2020, 2021; Stehn pers. comm.

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2022). The sites at which *Xylosma parvifolia* occur were previously subject to heavy browsing by feral goats, which is inferred to have kept the plant community stunted and reduced competition (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022). However, plant height and cover has increased in this community following the eradication of goats from Lord Howe Island in the late 1990s and early 2000s, with a corresponding decline in the health of *X. parvifolia*, likely because they are crowded out by more competitive species as sites succeed to a climax community in the absence of the continued disturbance provided by goats.

This threat is likely to affect individuals at sites not accessible to monitoring, and may affect other monitoring sites over time as communities continue to adjust to changes in browsing pressure. There is currently no clear approach to ameliorating this issue. It is possible that the recent eradication of rats and removal of grazing pressure by rodents on the island may have a similar effect at other sites, and ongoing monitoring is important to inform management.

## *Landslips*

*Xylosma parvifolia* is restricted to rocky ridgelines and exposed cliff faces that are susceptible to collapse and slips, particularly following heavy rain (NSW Government Saving our Species, 2021; C. Stehn pers. comm. 2022). Landslips in 2021 prevented access to some monitoring sites (NSW Government Saving our Species, 2021c). There is currently no way to prevent or mitigate the threat of landslips at sites where *X. parvifolia* is present (C. Stehn pers. comm. October 2022). Climate change may increase the likelihood and severity of sub-tropical storms on and around Lord Howe Island, posing an additional severe threat to plant communities towards the peaks of Mount Gower and Lidgbird (Auld and Leishman 2015). These storms may damage *X. parvifolia* directly or increase the likelihood of landslips following heavy rain.

Landslips may be an historic mechanism by which new habitat was made available to *Xylosma parvifolia* and other cliff-dwelling colonist species on Lord Howe Island (C. Stehn pers. comm. October 2022). *X. parvifolia* is a poor competitor, and so this kind of disturbance is likely necessary to open new habitat into which *X. parvifolia* can move (C. Stehn pers. comm. 2022). However, while landslips may have historically provided new habitat, introduced weeds and native competitors pose a severe competitive challenge in any new habitat, and *X. parvifolia* has not been observed to successfully colonise any new sites since monitoring began in the early 2000s (C. Stehn pers. comm. October 2022).

## *Increased likelihood and severity of storms as a consequence of climate change*

Climate change may increase the likelihood and severity of sub-tropical storms on and around Lord Howe Island, posing an additional severe threat to plant communities towards the peaks of Mount Gower and Lidgbird (Auld & Leishman, 2015). These storms may damage *Xylosma parvifolia* directly or increase the likelihood of landslips.

## *Root-rot, Phytophthora cinnamomi*

*Phytophthora cinnamomi* is an introduced water mould (oomycetes) pathogen that has had a devastating effect on plant communities world-wide, causing catastrophic dieback in many species. 'Dieback caused by the root-rot fungus *P. cinnamomi*' is listed as the Key Threatening Process on the EPBC Act and the BC Act. While there



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has been no specific research into its effect on Salicaceae or *Xylosma*, *P. cinnamomi* affects an enormous variety of plants across families and may pose a threat to *Xylosma parvifolia* (Government of South Australia Phytophthora Technical Group, 2006; NSW Department of Environment and Climate Change, 2008).

*Phytophthora cinnamomi* was detected in a small orchard on Lord Howe Island in 2003 and is now considered a resident threat on the island (Auld & Hutton, 2004). It has so far been contained, however the movement of residents and tourists across the island, and changes in overland water flows as a consequence of changed storm patterns risk spread in the future.

## **Assessment against IUCN Red List criteria**

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

### **Criterion A                      Population Size reduction**

Assessment Outcome: Data Deficient

Justification: There is insufficient data on historic population size, decline, and life history in *Xylosma parvifolia* to make assessments under Criterion A. *Xylosma parvifolia* has been recorded on Lord Howe Island since the late 1980s, however targeted surveys for the species have only been recorded since 2001, with formalised ongoing monitoring beginning in 2017. As a result, there is insufficient data on historic population size, decline and life history to describe historic trends in population size.

### **Criterion B                      Geographic range**

Assessment Outcome: Critically Endangered under B1ab(iii,v) and B2ab(iii,v)

Justification: *Xylosma parvifolia* is restricted to a small number of cliff faces and rocky ridges in the Southern Mountains region of Lord Howe Island. As a result, both EOO and AOO for *X. parvifolia* are 8 km<sup>2</sup>, below the threshold for Critically Endangered for Criterion B1 (EOO <100 km<sup>2</sup>) and Critically Endangered for B2 (AOO < 10 km<sup>2</sup>).

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 1 (CR), ≤5 (EN) or ≤10 (VU) locations.

Assessment Outcome: Met for Critically Endangered (1 location)

Justification: Being restricted to a very small area of rocky ridge and cliff in the Southern Mountains region of Lord Howe Island (AOO/EOO = 8 km<sup>2</sup>), means that the most serious plausible threats are highly likely to affect *Xylosma parvifolia* across its entire range. *Xylosma parvifolia* is only found at one threat location, defined by decline in habitat quality and mature population as a consequence of changes in disturbance regimes and recruitment. Both mortality as a consequence of increasing hydrological deficit due to climate change, and increasing weed encroachment

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exacerbated by climate change and the removal of rodents also define a single threat location. There is no evidence that *X. parvifolia* is severely fragmented.

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

Assessment Outcome: Met – Continuing decline is inferred in (iii) area, extent and/or quality of habitat, and (v) number of mature individuals.

Justification: Observed and projected reduction in rainfall and humidity driven by climate change is inferred to reduce the quality of the habitat available to *Xylosma parvifolia*. The species is completely restricted to cliff faces and rocky ridges in the Southern Mountains region (NSW Government Office of Environment and Heritage, 2016). This habitat is likely to experience increasing hydrological deficit and become less suitable for *X. parvifolia* as rainfall declines, and it becomes more susceptible to encroachment by generalist weed species following rodent eradication. *Xylosma parvifolia* does not compete well with endemic or introduced species and so is unlikely to successfully compete for new habitat if it does become available as vegetation communities on peaks shift in response to climate change.

Three mature individuals were lost at the monitoring site above Goat House Cave between 2016/17 and 2020/21, inferred to be a result of ecosystem progression and increased interspecific competition at these sites (C. Stehn pers. comm. October 2022). This constitutes a loss of 10% of the mature plants at this monitoring site. This threat is currently unmanaged and competition is likely to result in the loss of more mature individuals over time. This threat may currently affect plants at sites not accessible to monitoring and may affect other monitoring sites over time as communities continue to adjust to changes in browsing pressure since the removal of goats and rodents. There is currently no clear approach to ameliorating this issue.

Introduced rodents have also historically exerted strong grazing pressure, and their recent eradication may also contribute to crowding and weed encroachment at Goat House and other sites.

- c) Extreme fluctuations.

Assessment Outcome: Not Met

Justification: There is no evidence for extreme population fluctuations in *Xylosma parvifolia*.

## **Criterion C Small population size and decline**

Assessment Outcome: Endangered C2a(i,ii)

Justification: The mature population of *Xylosma parvifolia* is estimated to be 180-200 plants, below the threshold for Critically Endangered under Criterion C. This number is drawn from ongoing monitoring at seven permanent monitoring sites, the results of which are then extrapolated across all sites and habitat at which *X. parvifolia* is known to occur to produce a total population estimate.

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

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

Assessment Outcome: Data Deficient

Justification: *Xylosma parvifolia* was described on Lord Howe Island in the late 1980s, however formalised ongoing monitoring only began in 2017. As a result, there is insufficient data on historic population size, decline and life history to describe decline in population size.

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

Assessment Outcome: Met

Justification: Three mature individuals were lost at the monitoring site above Goat House Cave between 2016/17 and 2020/21, likely as a result of competition with other common native plant species as a consequence of ecological progression (C. Stehn pers. comm October 2022). There is no targeted management currently underway to address this threat, and so it is likely more individuals will be lost in the future. This threat is also likely to be exacerbated by competition from weeds and increasing hydrological deficit as a result of climate change in the future.

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

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

Assessment Outcome: Met for Endangered ( $\leq 250$  in each subpopulation)

Justification: All mature individuals occur in a single subpopulation with an estimated size of 180-200 plants.

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

Assessment Outcome: Met for Critically Endangered (90 - 100% mature in one subpopulation)

Justification: All mature individuals occur in a single subpopulation. The species is wind pollinated and occurs across a very small area so there is likely to be genetic flow between all known sites.

- b. Extreme fluctuations in the number of mature individuals

Assessment Outcome: Not Met

Justification: There is no evidence for extreme population fluctuations in *Xylosma parvifolia*.

## **Criterion D Very small or restricted population**

Assessment Outcome: Met for Endangered (<250 mature individuals)

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Justification: The mature population of *Xylosma parvifolia* is estimated to be 180-200 plants. This number is drawn from ongoing monitoring at seven permanent monitoring sites, the results of which are then extrapolated across all sites and habitat at which *X. parvifolia* is known to occur to produce a total population estimate.

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

D1. Population size estimated to number fewer than 250 mature individuals.

Assessment Outcome: Met for Endangered D1 (<250 mature individuals)

Justification: All mature individuals occur in a single subpopulation with an estimated size of 180-200 plants.

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: Met for Vulnerable D2

Justification: The entire population of *Xylosma parvifolia* is known from only a single location with a small total AOO (8 km<sup>2</sup>), and a single threat could contribute to the extinction of the species in a very short time. A large landslip, a *Phytophthora* outbreak, or severe and ongoing drought could plausibly drive the species to extinction within one generation.

## **Criterion E Quantitative Analysis**

Assessment Outcome: Data Deficient

Justification: There has been no quantitative analysis conducted for *Xylosma parvifolia*.

## **Conservation and Management Actions**

*Xylosma parvifolia* 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 species is extant in the wild in 100 years. *Xylosma parvifolia* sits within the site-managed management stream of the SoS program.

Activities to assist this species currently recommended by the SoS program include:

### Habitat loss, disturbance and modification

- Broad-scale weed control continuing across the Southern Mountains region under the Lord Howe Island Weed Management Strategy.
- Ongoing monitoring for rodent re-invasion following the completion of the Lord Howe Island Rodent Eradication Project.
- Continue to implement sanitation measures across the island, to reduce risk of *Phytophthora* spreading outside of the containment zone.

### Ex situ conservation

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- Seeds collected from multiple individuals/locations and over several collection events as the opportunity arises.

## Survey and monitoring

- Permanently tag and monitor accessible *Xylosma parvifolia* individuals and record details of height class, age structure and reproductive status.
- Continue monitoring trends in weed invasion.
- Identify and estimate *Xylosma parvifolia* populations outside of monitoring sites.

## Research priorities

- Undertake research into the species reproductive biology, dispersal and colonization.

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## **Expert Contacts**

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Craig Stehn - NSW Department of Climate Change Energy, the Environment and Water

Hank Bower – Lord Howe Island Board (at time of contact)

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## Appendix 1

### Assessment against Biodiversity Conservation Act criteria

The Clauses used for assessment are listed below for reference.

**Overall Assessment Outcome:** *Xylosma parviflora* was found to be eligible for listing as Critically Endangered under Clauses 4.3(a)(d)(e,i,iii)

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

**Assessment Outcome: Data Deficient**

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

### Clause 4.3 - Restricted geographic distribution of species and other conditions (Equivalent to IUCN criterion B)

**Assessment Outcome: Critically Endangered 4.3(a)(d)(e,i,iii)**

<b>The geographic distribution of the species is:</b>			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
<b>and at least 2 of the following 3 conditions apply:</b>			
	(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: Endangered 4.4(b)(ei,ii(A(II),B))**

<b>The estimated total number of mature individuals of the species is:</b>			
	(a)	for critically endangered species	very low, or
	(b)	for endangered species	low, or
	(c)	for vulnerable species	moderately low,
<b>and either of the following 2 conditions apply:</b>			
	(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: Endangered 4.5(b)**

<b>The total number of mature individuals of the species is:</b>			
	(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**

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

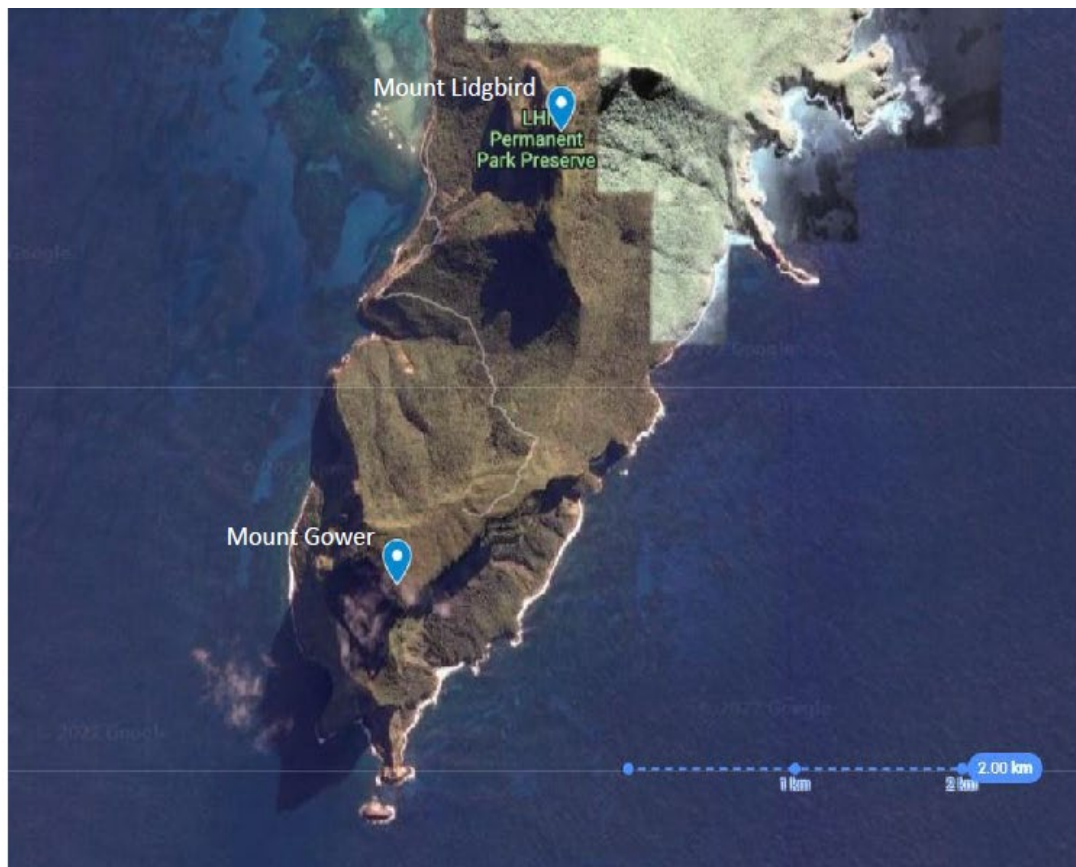
**Clause 4.7 - Very highly restricted geographic distribution of species–vulnerable species**

**(Equivalent to IUCN criterion D2)**

**Assessment Outcome: Met for Vulnerable**

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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## Appendix 2 – Site Photo



- 1. Mount Gower and Mount Lidgbird, Lord Howe Island.** Blue lines show 2km length for scale. *Xylosma parvifolia* occurs in scattered patches on the ridgeline between the peaks of Mount Lidgbird and Mount Gower.