

NSW Threatened Species Scientific Committee

Conservation Assessment of Hutton's *Geniostoma*, *Geniostoma huttonii*, B.J.Conn (Loganiaceae)

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NSW Threatened Species Scientific Committee

***Geniostoma huttonii*, B.J.Conn (Loganiaceae)**

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 threat – increasing threat of habitat decline as a consequence of weed invasion and increasing aridity as a result of climate change, and ongoing decline in the number of mature individuals as a consequence of increased competition driven by changes in ecological community structure and disturbance regimes.

Geniostoma huttonii was assigned an Endangered status under previous NSW legislation *Threatened Species Conservation Act 1995* where the highest threat category available at the time of listing (2001) was Endangered.

Summary of Conservation Assessment

Geniostoma huttonii was found to be eligible for listing as Critically Endangered under IUCN Red List Criteria B1ab(iii, v) and C2a(ii). The main reasons for this listing are: 1) it has a very highly restricted geographic range; 2) the total number of mature individuals is extremely low; 3) it is found at only a single location, scattered across a small area of ridgeline and cliffs in the Southern Mountains region of Lord Howe Island; 4) there is inferred continuing decline in habitat quality as a consequence of increased aridity driven by climate change, ongoing weed invasion, and changes in community structure and disturbance regimes; and 5) there is ongoing decline in the number of mature individuals as a consequence of increased competition driven by changes in ecological community structure and disturbance regimes.

Description and Taxonomy

Geniostoma huttonii was discovered in 1991 and first formally described by Conn, 1993 (Conn, 1993; Green, 1993). There have been no subsequent taxonomic revisions. Conn (1993) describes *Geniostoma huttonii* as a:

'Scrambling shrub to 1 m high. *Branches* slightly compressed laterally on distal internodes; distal internodes with 2 pairs of lateral ridges extending from between the leaf bases to the next more basal node; glabrous; stipules interpetiolar, depressed triangular to collar-like, 1-1.4 mm long, glabrous, distally rounded. *Leaves* glossy mid-green, glabrous; petiole 4-6 mm long; lamina ovate, 20-30 mm long, (9-)14-16 mm wide [length to width ratio 1.5-1.91; base acute to shortly subattenuate; margin entire; apex subacute to subacuminate; midrib raised on lower surface, slightly sunken on upper surface, veins indistinct. *Inflorescence* axillary, 1-3-flowered, possibly to 5-flowered (see note below), less than 10 mm long; peduncle absent or up to 1 mm long; pedicels c. 2 mm long, glabrous; bracts ovate, c. 0.5 mm long, glabrous, with margin shortly fimbriate. *Calyx* 1.3-1.5 mm long; outer surface glabrous; inner surface moderately hairy, hairs minute, to c. 0.1 mm long; lobes ovate-triangular, 0.6-1 mm long, margin shortly fimbriate, apex acute; veins not distinct. *Corolla* 5(or 6)-merous,

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campanulate, 2.5-3.5 mm long; outer surface glabrous; tube 0.8-1 mm long, with inner surface glabrous; lobes 2.5-3 mm long, glabrous basally, papillose distally; margin papillose to shortly fimbriate (hairs <0.05 mm long); venation complex, each lobe supplied by one vein which has usually divided in the upper part of the tube to produce 2 lateral branches which ascend into the lobe, with short to long divergent branchlets usually present. *Staminal filaments* narrowly ovoid to slightly ligulate, c. 1 mm long, c. 0.4 mm wide, moderately hairy on ventral surface, hairs to 0.1 mm long, glabrous dorsally; anthers ovate, slightly incurved distally, 0.5-0.6 mm long, basal lobes obtuse, glabrous, apex sparsely to moderately covered with patent hairs to 0.1 mm long, connective slightly extended to form a minute triangular, apical appendage c. 0.1 mm long. *Pistil* 1.4-2 mm long; ovary glabrous, c. 0.5 mm long; style 0.2-0.6 mm long, moderately hairy with patent hairs to 0.1 mm long; stigma ellipsoid, 0.3-0.7 mm long. *Capsule* globular to slightly ellipsoid, 5-6 mm diameter...Although the inflorescence is usually uniflorous or triadic, it is either derived from a botryoidal or metabotryoidal inflorescence because of the prophylls and metaxyphylls (together there are usually 2 pairs, rarely 3 pairs)'.

Conn (1993) also describes *Geniostoma huttonii* as being readily distinguished from the related *Geniostoma petiolosum*, which also occurs on Lord Howe Island.

'*Geniostoma huttonii* is readily distinguished from *G. petiolosum*, the other species that occurs on the island, by several characters. *Geniostoma huttonii* has smaller leaves (petiole 4-6 mm long; lamina ovate, 20-30 mm long, (9-)14-16 mm wide) than *G. petiolosum* (petiole 10--15 mm long and lamina narrowly ovate-oblong to oblongelliptic, 80-115 mm long, 20-35 mm wide). The inflorescence of the former species is few-flowered, probably less than 5-flowered, and less than 10 mm long, whereas *G. petiolosum* has a mostly botryoidal or metabotryoidal inflorescence, although sometimes triadic, and (8-)10-20 mm long. *Geniostoma huttonii* has short peduncles (up to 1 mm long or absent) and pedicels (c. 2 mm long), whereas, *G. petiolosum* has longer peduncles (3-4 mm long) and pedicels (4-6 mm long). The calyx of *G. huttonii* is 1.3-1.5 mm long, with inner surface moderately covered with minute hairs, whereas *G. petiolosum* has a larger glabrous calyx (2.5-4 mm long). *Geniostoma huttonii* is a scrambling shrub (usually less than 1 m high), whereas *G. petiolosum* is a small tree (2-5 m high). The flowers of *G. huttonii* lack an odour, but those of *G. petiolosum* are very strongly and pungently aromatic. The affinities of this new species are not clear, but there are strong similarities to *G. antherotrichum* of New Guinea. Both species lack hairs on the inner surface of the corolla and have similar venation patterns on the corolla lobes. The two species have reduced inflorescences and similar sized leaves (characteristic of *G. antherotrichum* var. *archboldianum*, rather than of the typical variety of the latter). However, the short pistil (reduced style) of *G. antherotrichum* and the unusually thickened staminal filaments of *G. huttonii*...lessen the likelihood of the two taxa being closely related.'

Distribution and Abundance

Geniostoma huttonii is endemic to Lord Howe Island (NSW Government Office of Environment and Heritage, 2016). Lord Howe Island (31.54°S, 159.08°E) is the largest of a collection of small 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, 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, Mount Gower

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(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 sources combined with the island group's isolation has led to the evolution 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).

Geniostoma huttonii is restricted to the Southern Mountains region of Lord Howe Island, encompassing Mount Lidgbird (777 m elevation) and Mount Gower (875 m elevation) (NSW Government Office of Environment and Heritage, 2017). *Geniostoma huttonii* plants are scattered across cliff faces and rocky ridges at these sites from around above 400 m elevation, generally occurring as single plants, or in small patches (NSW Government Office of Environment and Heritage, 2017). The maximum distance between Mount Gower and Mount Lidgbird sites is around 2 km (C. Stehn pers. comm. 2022).

Much of the habitat 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, 2021b; 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, 2017; 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, 2021b). Of these, 80-90% are estimated to be mature. 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, 2021b; C. Stehn pers. comm. 2022). Based on these figures the mature population is estimated to be 160-200.

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, 2021b). Results are then extrapolated across the area over which *Geniostoma huttonii* is believed to occur, to produce a total population estimate (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b). Selection of sites for ongoing monitoring is primarily determined by accessibility, but sites are considered to provide a reliable representation of the broader population (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b). Land slips resulted in the loss of four mature plants from the 'Get Up Place' monitoring plot in 2021/22, and continue to make surveys impossible at several monitoring sites (NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022). However, despite ongoing challenges in access to some monitoring sites, surveys are still considered to provide an

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appropriate sample to produce population estimates. Competition with other species at two monitoring plots ('Get Up Place' and 'Goat House Cave') resulted in loss of eight mature plants between 2016 and 2021, and remains an ongoing threat to the mature population (C. Stehn pers. comm. 2022).

Since 2017, 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, 2021b; C. Stehn pers. comm. 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, 2021b).

Surveys conducted for *Geniostoma huttonii* 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 *G. huttonii* 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 validated occurrence records drawn from BioNet and recent monitoring reports (NSW Government Office of Environment and Heritage, 2016; NSW Office of Environment and Heritage, 2022). This yielded 44 records, describing different clusters of closely grouped plants spread across the cliffs and ridgelines between 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 (IUCN Standards and Petitions Committee, 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 the IUCN (2022).

AOO for *Geniostoma huttonii* is 12 km². Surveys since 2001 have detected *G. huttonii* 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 *G. huttonii* occurs in an area that can be contained within three 2 km x 2 km grid squares, which is the smallest standard grid resolution recommended for assessments of AOO under the (IUCN Standards and Petitions Committee (2022).

Geniostoma huttonii is restricted to small lengths of cliff and exposed ridgeline on Mount Gower and Mount Lidgbird, and as a result EOO (1.813 km²) is less than the estimated AOO (12 km²). Where EOO is less than or equal to AOO then 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 *G. huttonii* is also 12 km².

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

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

Ecology

Geniostoma huttonii is restricted to sunny, exposed, north and west facing cliff faces and ridges, generally above 400 m elevation (NSW Government Office of Environment and Heritage, 2016). *Geniostoma huttonii* occurs in open, exposed sites without canopy cover, and does not tolerate crowding (NSW Government Office of Environment and Heritage, 2016; C. Stehn pers. comm. 2022). The species shares general habitat and features of ecology with three other threatened plants, *Carmichaelia exsul*, *Xylosma parvifolium* 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

Geniostoma huttonii produces small white flowers singly or in pairs at the base of the leaf stem from January to March (NSW Government Office of Environment and Heritage, 2016). *Geniostoma* species are often insect pollinated, although may also be visited by birds, and this is likely to also be true of *G. huttonii* (Newstrom & Robertson, 2005; Papadopulos et al., 2011).

Given the very restricted range of *Geniostoma huttonii* it is unlikely that the population is severely fragmented. The population appears to be viable, with pollinators likely able to access individuals across its very highly restricted range, and birds able to disperse seed easily and consistently across suitable habitat.

There has been no study into dispersal mechanism in *Geniostoma huttonii*, or in related species. *Geniostoma huttonii* produces small (~6mm), green capsules that split open to expose black seeds (NSW Government Office of Environment and Heritage, 2016). These seeds may be bird- or ant-dispersed, or dispersed by rain or wind (Newstrom & Robertson, 2005; Papadopulos et al., 2011).

During two decades of monitoring, *Geniostoma huttonii* has not been observed to colonise any 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 for new space (C. Stehn pers. comm. 2022). Cliff-dwelling species like *G. huttonii* are commonly specialised to 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 reduces their competitiveness with invasive and endemic generalist species in 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 & 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:

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“...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...”

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 *Geniostoma huttonii* (Auld & Leishman, 2015). ‘Anthropogenic climate change’ is listed as a Key Threatening Process under the Act.

Acute drought is inferred to pose a threat to *Geniostoma huttonii* based on the general reliance of Lord Howe plants on high water-availability, and observed decline in other Lord Howe Island plant species and ecosystems as a result of drought. Drought from 2018 to 2021 severely impacted multiple Lord Howe Island plant species and communities, and demonstrated 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). There was no loss of *G. huttonii* between 2018-2021 as a result of this drought, however loss of individuals was observed in *Coprosma inopinata*, a species with which *G. huttonii* shares range, habitat, and many features of ecology and life history, and it is possible that future droughts may similarly affect *G. huttonii* (NSW Government Saving our Species, 2021b). Droughts across Australia are becoming more severe as the background climate becomes more arid (Abram *et al.*, 2021), and this is inferred to increase the threat drought poses to endemic Lord Howe Island species, including *Geniostoma huttonii*.

Loss of cloud and habitat loss as a result of climate change

The ongoing effects of climate change on the Lord Howe Island group pose a direct threat to *Geniostoma huttonii*. Plant species on Lord Howe Island depend on consistent and ongoing formation of cloud to provide the high humidity and moisture on which they depend (Auld & Leishman, 2015). 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, dubbed the ‘lift-cloud-base hypothesis’ (Auld & Leishman, 2015).

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

Geniostoma huttonii is confined to cliffs and ridges at relatively high elevations (~400-600m), above which habitat is generally unsuitable, opening into plateaus dominated by dense vegetation, especially the Gnarled Mossy Cloud Forest ecological

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community (C. Stehn pers. comm. 2022). The general lack of exposed cliffs and ridgelines at higher elevations means that there is no suitable habitat into which *G. huttonii* can move as increasing aridity makes their current habitat less suitable (C. Stehn pers. comm. 2022).

As a poor competitor, *Geniostoma huttonii* 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 *G. huttonii*, components of these communities, like established trees or generalist weed species, are likely to persist and present an ongoing barrier to colonisation.

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 *Geniostoma huttonii* directly or increase the likelihood of landslips.

Landslips

Geniostoma huttonii 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 resulted in the loss of four mature plants from the 'Get Up Place' monitoring plot in 2021/22, and continue to make surveys impossible at several other monitoring sites (NSW Government Saving our Species, 2021b). There is currently no way to prevent or mitigate the threat of landslips at sites where *G. huttonii* is present, however efforts are underway to develop new methods to address this challenge (C. Stehn pers. comm. 2022).

Landslips may be a historic mechanism by which new habitat was made available to *Geniostoma huttonii* and other cliff-dwelling colonist species on Lord Howe Island (C. Stehn pers. comm. 2022). *Geniostoma huttonii* is a poor competitor, and so this kind of disturbance is likely necessary to open new habitat into which *G. huttonii* 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 *Geniostoma huttonii* has not been observed to successfully colonise any new sites since monitoring began in the early 2000s (C. Stehn pers. comm. 2022).

Competition by Invasive Weeds

Invasive weeds pose a severe and ongoing threat to *Geniostoma huttonii* (Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2017). Weeds encroach on the habitat of *G. huttonii*, outcompeting existing plants for resources and space and inhibiting recruitment by reducing the likelihood that *G. huttonii* 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* (Formosa 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 *G.*

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huttonii (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021; T. Auld pers. comm. 2022).

An ongoing intensive weed control program started in 2004 has resulted in a decline in the number of mature weeds encroaching on habitat of *Geniostoma huttonii* (Lord Howe Island Board, 2016; NSW Government Office of Environment and Heritage, 2017). There has been a reduction of 90% in mature weed plants on Lord Howe Island since weed eradication efforts began in 2004, and in 2020/21 only 0.01% of weeds removed in the Southern Mountains region were mature (NSW Government Office of Environment and Heritage, 2017; NSW Government Saving our Species, 2021b). 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, 2021b). This increase is possibly driven by drought and increasing aridity, with generalist weed species on Lord Howe Island likely more successful than endemics in changing environments, and by the removal of rats (Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021b). 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 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. 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. 2022). This program appears to have been successful and no evidence of rodents (rats and mice) has been detected since (H. Bower pers. comm. 2022). Intensive ongoing monitoring and biosecurity measures are in place.

Historically rodents have not been considered a severe direct threat to *Geniostoma huttonii* because of its inaccessible habitat, although browsing and fruit predation has been observed (Lord Howe Island Board 2017; C. Stehn pers. comm. 2022). However, there are indications that rodent control has inadvertently removed predation pressures from weed populations, as well as from native vegetation (C. Stehn pers. comm. 2022). In the absence of rodents, weed populations may increase and spread, posing a more significant threat to *G. huttonii* (NSW Government Saving our Species, 2021; C. Stehn pers. comm. 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 *Geniostoma huttonii* evolved, and the patterns of ecosystem progression and dispersal

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and by which *G. huttonii* maintained populations and spread to new habitat. However, the apparent lack of new colonisation by *G. huttonii* and a decline in mature individuals strongly suggests that there has been a shift in the patterns of disturbance and dispersal upon which *G. huttonii* was dependant.

Geniostoma huttonii 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 (NSW), 2007; Lord Howe Island Board, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022). Over two decades of monitoring *G. huttonii* has not been observed to colonise any new habitat, either in apparently suitable adjacent habitat, or in newly disturbed areas following landslips (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2019, 2020, 2021b; C. Stehn pers. comm. 2022). As a consequence of this apparent inability to colonise new habitat, *G. huttonii* is confined to the sites in which it is currently established, the habitat quality of which is in decline.

Geniostoma huttonii 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 may previously have provided ongoing disturbance at the sites at which *G. huttonii* 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 *Geniostoma huttonii* 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 *Geniostoma huttonii*, ultimately resulting in the loss of mature individuals (NSW Government Saving our Species, 2021b; C. Stehn pers. comm. 2022).

Seven 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 (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b; C. Stehn pers. comm 2022). This site, above Goat House Cave on Mount Lidgbird, was 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 *Geniostoma huttonii*, 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.

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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. It is listed as the Key Threatening Process 'Dieback caused by the root-rot fungus *Phytophthora cinnamomi*' on the EPBC Act and 'Infection of native plants by *Phytophthora cinnamomi*' under the NSW BC Act. *Phytophthora cinnamomi* affects a huge variety of plants across families, including Loganiaceae, and so may pose a considerable threat to *Geniostoma huttonii* (Government of South Australia Phytophthora Technical Group, 2006; NSW Department of Environment and Climate Change, 2008; Podger & Newhook, 1971).

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 risk its spread in the future.

Assessment against IUCN Red List criteria

For this assessment it is considered that the survey of *Geniostoma huttonii* 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 *Geniostoma huttonii* to make assessments under Criterion A. *Geniostoma huttonii* has been recorded on Lord Howe Island since the early 1990s, 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 trends in population size.

Criterion B *Geographic range*

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

Justification: *Geniostoma huttonii* is completely 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 *G. huttonii* are 12 km², below the threshold for Critically Endangered for Criterion B1 (EOO <100 km²) and Endangered for B2 (AOO < 10 km²).

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: *Geniostoma huttonii* is only found at one location, being restricted to a very small area of rocky ridge and cliff habitat in the Southern Mountains region of Lord Howe Island (AOO/EOO = 12 km²). This highly restricted distribution means that the most serious plausible threats, plant pathogens, weed invasion, increasing aridity, cloud lift, and habitat loss as a

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result of climate change are highly likely to affect *G. huttonii* across its entire range. There is no evidence that *G. huttonii* 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: Subcriterion 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 *Geniostoma huttonii*. The species is completely restricted to cliff faces and rocky ridges in the Southern Mountains region, and currently occupies all known suitable habitat (NSW Government Office of Environment and Heritage, 2016; NSW Government Saving our Species, 2021b). This habitat is likely to become increasingly arid and less suitable for *G. huttonii* as rainfall declines, and more susceptible to the threat of encroachment by generalist weed species. *Geniostoma huttonii* 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.

Seven 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 towards a climax community and increased competition at these sites (NSW Government Saving our Species, 2021b). This threat is currently unmanaged, and is likely 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. 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.

Geniostoma huttonii 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 resulted in the loss of four mature plants from the 'Get Up Place' monitoring plot in 2021/22, and continue to make surveys impossible at several other monitoring sites (NSW Government Saving our Species, 2021b). There is currently no way to prevent or mitigate the threat of landslips at sites where *G. huttonii* is present,

- c) Extreme fluctuations.

Assessment Outcome: Not Met

Justification: There is no evidence for extreme population fluctuations in *Geniostoma huttonii*.

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Criterion C *Small population size and decline*

Assessment Outcome: Critically Endangered under C2a(ii).

Justification: The mature population of *Geniostoma huttonii* is estimated to be 160-200 plants, below the threshold for Critically Endangered under C. This number is drawn from ongoing monitoring at 7 permanent monitoring sites, the results of which are then extrapolated across all sites and habitat at which *Geniostoma huttonii* is known or likely to occur to produce a total population estimate.

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: *Geniostoma huttonii* was described on Lord Howe Island in the early 1990s, 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 historic reduction in population size.

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

Assessment Outcome: Condition Met

Justification: There is inferred continuing decline in the number of mature individuals as a result of decline in habitat and poor recruitment. Seven 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 towards a climax community, and increased competition at these sites (NSW Government Saving our Species, 2021b). This threat is currently unmanaged, and is likely 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. 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.

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 Endangered (≤ 250 in each subpopulation)

Justification: All mature individuals occur in a single subpopulation with an estimated size of 160-200 plants.

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

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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 *Geniostoma huttonii*.

Criterion D *Very small or restricted population*

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

Justification: The mature population of *Geniostoma huttonii* is estimated to be 160-200 plants. This number is drawn from ongoing monitoring at 7 permanent monitoring sites, the results of which are then extrapolated across all sites and habitat at which *Geniostoma huttonii* is known to occur to produce a total population estimate.

To be listed as Vulnerable under D, 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: Met for Endangered

Justification: All mature individuals occur in a single subpopulation with an estimated size of 160-200 plants.

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: Met for Vulnerable.

Justification: The entire population of *Geniostoma huttonii* is known from only a single location with a small total AOO (12 km²), and a single threat could contribute to the extinction of the species in a very short time. In particular, a severe and ongoing drought or severe storms 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 *Geniostoma huttonii*.

Conservation and Management Actions

Geniostoma huttonii is currently listed on the NSW *Biodiversity Conservation Act 2016* and a conservation project has been developed by the NSW Department of Planning

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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. *Geniostoma huttonii* 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 success of the Lord Howe Island Rodent Eradication Project.
- Sanitation and biosecurity controls (eg. shoe-washing stations) to prevent the spread of *Phytophthora cinnamomi* by residents, tourists, and researchers moving from the mainland or island areas where *P. cinnamomi* is present.
- Consider management of habitat to support new recruit establishment.

Ex situ conservation

- Seeds collected from multiple individuals/locations and over several collection events.

Survey and monitoring

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

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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: Critically Endangered under Clauses 4.3 (a)(d)(e, i, iii) and 4.4 (a)(e, i, ii (B))

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

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	

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	(i)	an index of abundance appropriate to the taxon,
	(ii)	the geographic distribution of the species,
	(iii)	habitat area, extent or quality,
	(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:
	(i)	an index of abundance appropriate to the taxon,
	(ii)	the geographic distribution of the species,
	(iii)	the number of locations in which the species occur or of populations of the species.

Clause 4.4 - Low numbers of mature individuals of species and other conditions

(Equivalent to IUCN criterion C)

Assessment Outcome: Critically Endangered 4.4 (a)(e, i, ii (B))

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: Endangered 4.5 (b)

The total number of mature individuals of the species is:
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	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

**Clause 4.6 - Quantitative analysis of extinction probability
(Equivalent to IUCN criterion E)**

Assessment Outcome: Data Deficient

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

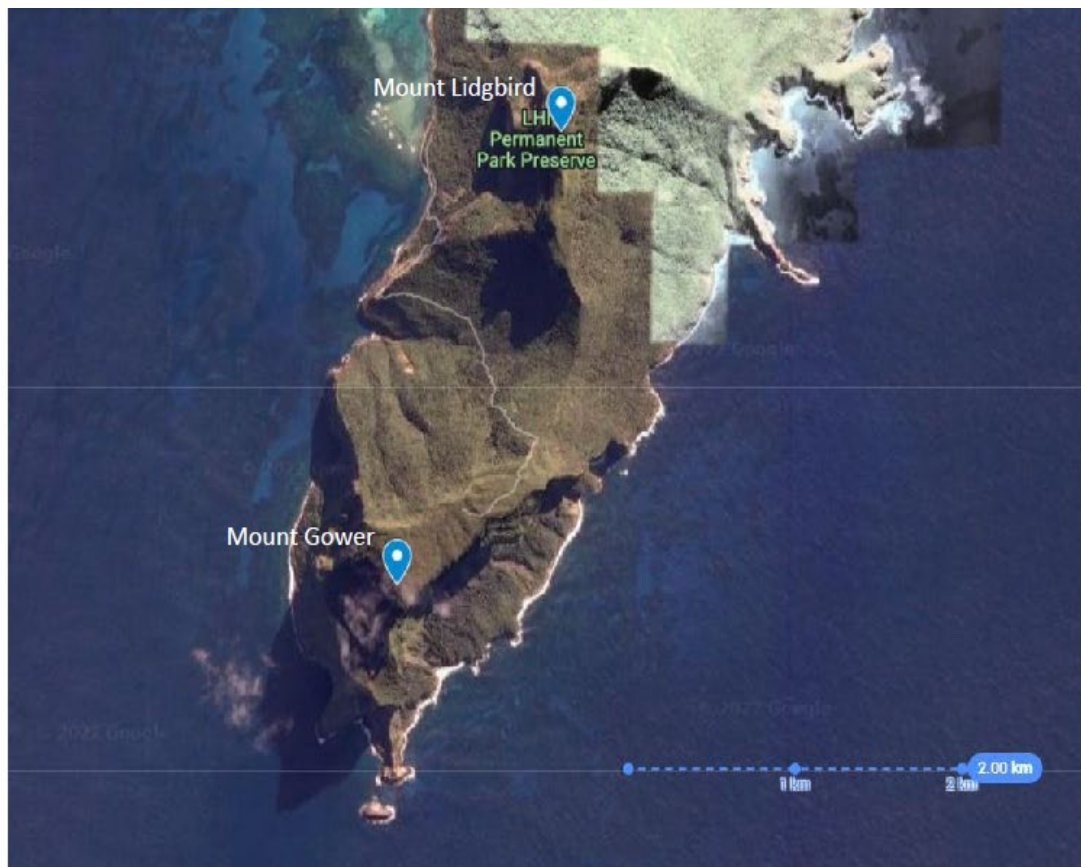
**Clause 4.7 - Very highly restricted geographic distribution of species–
vulnerable species**

(Equivalent to IUCN criterion D2)

Assessment Outcome: Not Met

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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Appendix 2 – Site Photo



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

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Appendix 3 – Monitoring Data

Table 1. Monitoring Data for *Geniostoma huttonii*. Table summarises reported monitoring data for *Geniostoma huttonii*. The consistent estimate of a total population of 200 is given by species experts based on this monitoring data, and observations of habitat outside of these sites.

Source	Year	Description	Site	No.Individuals
Mountains plan - (NSW Government Office of Environment and Heritage. (2016))	2001	Targeted threatened plant survey undertaken for <i>Geniostoma huttonii</i> in the Southern Mountains by Ian Hutton (Hutton 2001). Areas searched included: SE corner of Mt Lidgbird (several locations in this general area), Mt Lidgbird SW face, Razorback (Mt Gower), Get up Place (Mt Gower).	Mt Lidgbird: SE corner Mt Lidgbird, starting 35m from the top of the 'Pimple' and continuing for a further 90m	52
			Mt Lidgbird: Perpendicular transects from the above survey route (3 transects 10m long).	22
			Mt Lidgbird: Searches of additional ledges below the above survey route.	16
			Mt Lidgbird: SW Face	1
	2005	Targeted survey undertaken on Mt Gower (Razorback Ridge and the traverse into Little Pocket). (Hutton 2005).	Mt Gower: Razorback Ridge	3
			Mt Gower: Traverse into Little Pocket, from Razorback Ridge, from point 31° 35' 32" S 159° 04' 17" E.	~6 plants
	2010	Survey near the Get up Place on Mt Gower (LHIB 2012).	Mt Gower: Get up Place	10
	2016	Several new locations searched and additional plants found although changes in site naming and plot sizes make trends hard to determine (LHIB 2017).	Mt Gower track	22 plants (40 in vicinity)
		Mt Lidgbird: Goat House	25 plants (100 in vicinity)	
2018/2019 SOS Report Card - (NSW Government Saving our Species. (2019))	2018/19	SoS monitoring across all monitoring plots on Mt Gower and Mt Lidgbird - individual plot counts are not provided	Mt Gower and Mt Lidgbird monitoring plots	53 (29 in vicinity)
2020/2021 SOS Report Card - (NSW Government Saving our Species. (2021b))	2020/2021	SoS monitoring across all monitoring plots on Mt Gower and Mt Lidgbird - individual plot counts are not provided - authors note not all sites were accessible due to land slips	Mt Gower and Mt Lidgbird monitoring plots	37