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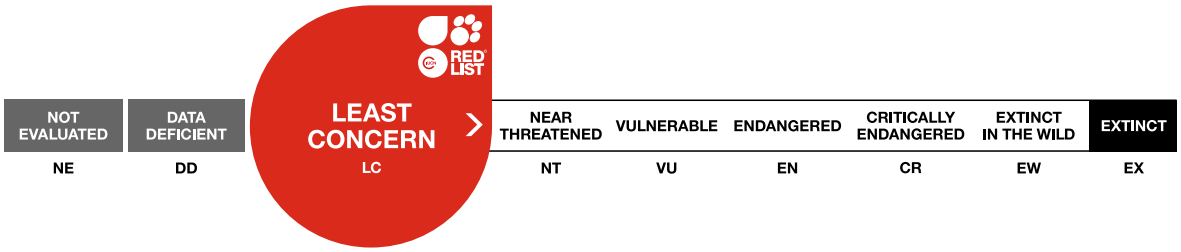
# *Bryoria fremontii,* Wila

**Assessment by: Chandler, A., Meredith, C.R., McMullin, T. & Allen, J.**

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# Taxonomy

| Kingdom | Phylum | Class | Order | Family |
|---|---|---|---|---|
| Fungi | Ascomycota | Lecanoromycetes | Lecanorales | Parmeliaceae |

**Scientific Name:** *Bryoria fremontii* (Tuck.) Brodo & Hawksw.

**Synonym(s):**

- *Alectoria fremontii* Tuck.
- *Alectoria jubata* (L.) Ach.

**Common Name(s):**

- English: Wila, Black Moss, Black Tree Beard, Black Tree Lichen, Edible Horsehair Lichen, Fremont's Horsehair Lichen, Tree Hair
- Salishan languages: Wila

**Taxonomic Notes:**

This species is one of the morphologically similar *Bryoria* species once referred to as *Alectoria jubata* (Turner 1977). More recent taxonomic work comparing DNA suggested that *B. tortuosa* and *B. fremontii* are conspecific and that variation between the two can instead be attributed to differences between North American and European habitats (Goward 1999, Velmala *et al.* 2009, Myllys *et al.* 2011).

# Assessment Information

**Red List Category & Criteria:** Least Concern ver 3.1

**Year Published:** 2020

**Date Assessed:** August 13, 2020

**Justification:**

*Bryoria fremontii* is an abundant species in parts of western North America and Eurasia. This species is an important traditional resource for many indigenous people in North America and has historically been used as a source of dye, food, clothing, and medicine (Turner 1977, Brodo *et al.* 2001, Crawford 2007). Though several threats are likely to impact *B. fremontii*, its broad distribution and abundance makes it unlikely that any threats present a substantial risk of extinction at this time. Given its broad distribution and the absence of indicators for widespread population decline, *B. fremontii* is currently listed as Least Concern.

# Geographic Range

**Range Description:**

*Bryoria fremontii* has a broad distribution, occurring in western North America and Eurasia (Oxner 1956, Turner 1977, Trass and Randlane 1994, Goward 1999, Golubkova 1996, Brodo *et al.* 2001, Ryan 2002, Lindgren *et al.* 2014, Velmala *et al.* 2009, Rambo 2012, Rambo and North 2012, CPNWH 2020). In North America, the core range of this species spans from the Northwest Territories south to northern Baja


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California and extends west to include Alberta, Idaho, and the Rocky Mountains of Montana and Wyoming (Turner 1977, Hayward and Rosentreter 1994, Bennett and Wetmore 1999, Goward 1999, Brodo *et al.* 2001, Eversman *et al.* 2002, Nash *et al.* 2002, Ryan 2002, Lehmkuhl 2004, Goward and Campbell 2005, Velmala *et al.* 2009, Rambo 2012, Rambo and North 2012, Lindgren *et al.* 2014, McCune and Geiser 2014, CPNWH 2020). Disjunct subpopulations occur in northern Ontario, northern Manitoba, and Colorado (Turner 1977, Rambo 2012, Lewis and McMullin 2013, Newmaster *et al.* 2013). Despite its occurrence in northern Baja California, the last collection of *Bryoria fremontii* from the Sonoran Desert region was made in 1904 in Riverside, California and it is thus suspected to be extirpated from this region (Ryan 2002). Additionally, past identifications of *B. fremontii* from Arizona are likely *B. fuscescens* and the species is not thought to occur there (Ryan 2002).

The Eurasian distribution for *B. fremontii* includes Finland, Sweden, Norway, Russia, and the Ural Mountains (Oxner 1956, Trass and Randlane 1994, Golubkova 1996, Tarhanen *et al.* 2000, Velmala *et al.* 2009, Myllys *et al.* 2011, Lindgren *et al.* 2014, Tarasova *et al.* 2016, Timdal 2020). It is considered rare in western Europe (Clauzade and Roux 1983) and is absent from Estonia and the Czech Republic (Trass and Randlane 1994, Liška *et al.* 2008). In a recent treatment of the lichen flora of the Alps, it was mentioned that there are no confirmed occurrences of the species (Nimis *et al.* 2018).

While there are a few reported observations from the Canary Islands and Germany (Hawksworth 1982, Velmala *et al.* 2009, Wirth *et al.* 2011, 2013), these require further verification. D.L. Hawksworth (1982) reported two specimens found on *Pinus canariensis* in the Canary Islands and noted this as the first occurrence in both Africa and the Atlantic Islands. Recent Canary Island studies have not reported *B. fremontii* as being present on the island of El Hierro (van den Boom and Ertz 2012). No species of *Bryoria* have yet to be reported from Gran Canaria, La Gomera, La Palma, and Lanzarote (van den Boom 2010a, 2010b, van den Boom and Clerc 2015, 2017, van den Boom *et al.* 2015). The genus *Bryoria* is also not included in personal collections made by French botanist J.M. Despréaux between the years of 1833 and 1839 from the island of Tenerife (Aguirre-Hudson *et al.* 2011). There is one historical record of the species from Germany (Freudenstadt, Schindler, collected 1968, on *Acer pseudoplatanus*, near a road), however, Wirth *et al.* (2013) states that it has not been found in recent times. For these reasons, both Germany and the Canary Islands are not included in the species' distribution for this assessment.

Though past literature has included *B. fremontii* as occurring in the Russian Far East (i.e. Sakhalin Island and the Kamchatka Peninsula) and in the Carpathian Mountains (Oxner 1956, Golubkova 1996), Velmala *et al.* (2009) found occurrences in these areas to be doubtful on the basis that they could not be confirmed. Prior collections from Poland and the Slovakian Tatry Mountains in the Carpathian range are likely misidentifications (Lisická 2005, Fałtynowicz and Kossowska 2016). In a lichen flora checklist of the Russian Arctic (Andreev *et al.* 1996) the species is noted as occurring only in the Polar Ural Mountains. The Checklist of Lichens of Russia notes *B. fremontii* as occurring in northern and central European Russia, the northern Ural Mountains, and the Polar Ural Mountains (Andreev 2010). The same checklist notes uncertainty as to whether or not the species is present in southern Siberia, as well as both northern and southern Far East Russia (i.e. Sakhalin Island and the Kamchatka Peninsula). Given all of this information, Far East Asia occurrences and those in the Carpathian Mountain Range are not included in the distribution of *B. fremontii* here.

### Country Occurrence:

**Native, Extant (resident):** Canada (Alberta, British Columbia, Manitoba, Ontario, Yukon); Finland;

Mexico (Baja California); Norway; Russian Federation (East European Russia, North European Russia, Northwest European Russia, West Siberia); Sweden; United States (California, Colorado, Idaho, Montana, Oregon, Washington, Wyoming)

**Native, Presence Uncertain:** Germany; Russian Federation (Kamchatka, Sakhalin); Spain (Canary Is.)


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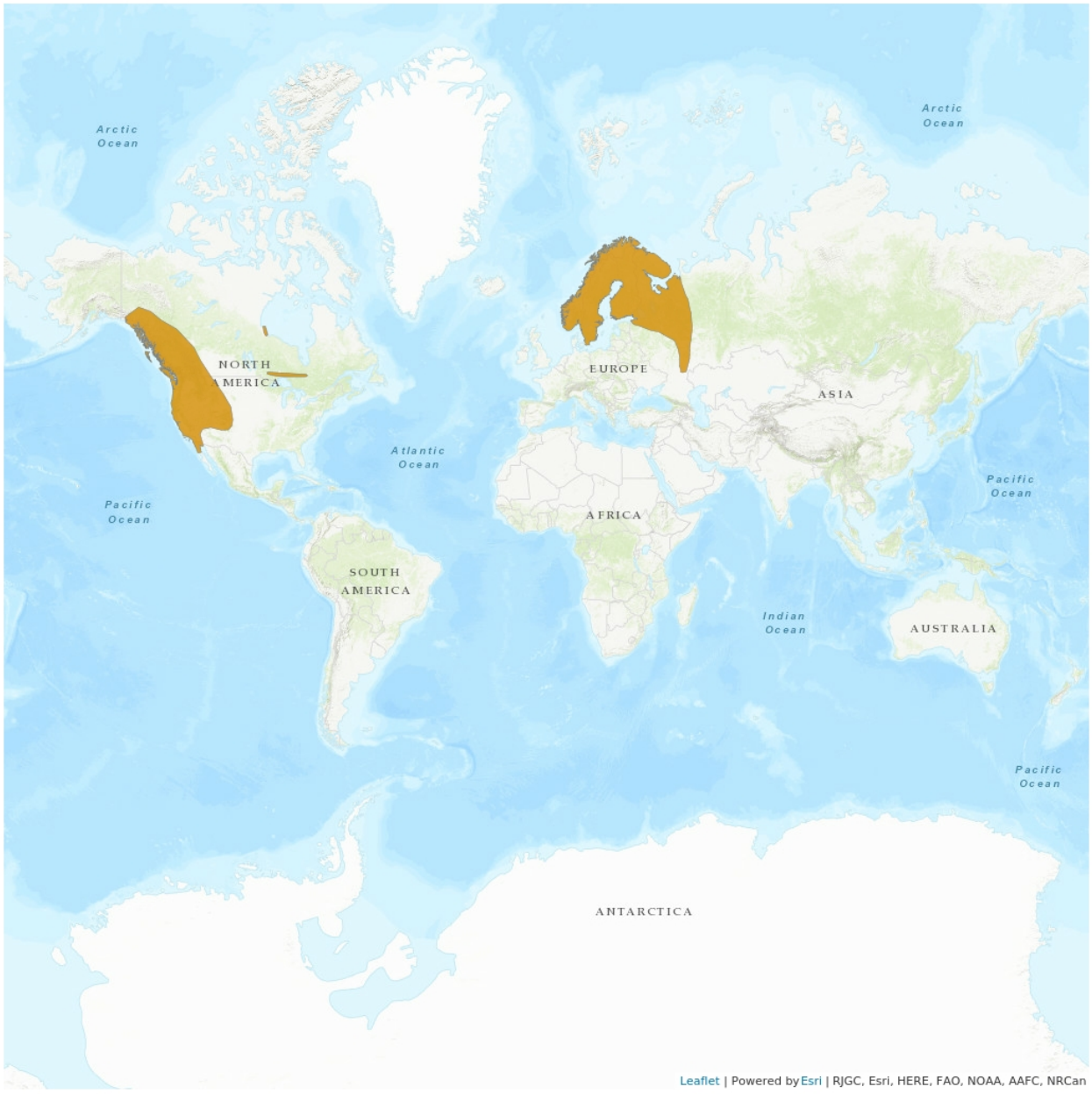
# Distribution Map




Legend

EXTANT (RESIDENT)

Compiled by:

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The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.


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## Population

Past taxonomic confusion within the genus *Bryoria* has obscured information related to population demographics for this species and, as a result, comprehensive population data is currently unavailable. However, *B. fremontii* is abundant in suitable habitats and is thought to grow at highest abundances in the upper canopies of clustered, old-growth conifers (Trass and Randlane 1994, Goward 2003, Goward and Campbell 2005, Rambo and North 2012). Larger subpopulations are typically found within stands as opposed to individual trees standing alone (Goward and Campbell 2005). There is no current indication that this species is declining rapidly enough globally to warrant concern of it becoming extinct in the near future. However, abundances of Sequoia National Park populations have been in decline over the last 30-40 years (Rambo 2012, Rambo and North 2012).

**Current Population Trend:** Unknown

## Habitat and Ecology **(see Appendix for additional information)**

*Bryoria fremontii* is found in low-elevation to subalpine mixed conifer forests, with both closed and open canopies (Hayward and Rosentreter 1994, Trass and Randlane 1994, Golubkova 1996, Goward 1999, Brodo *et al.* 2001, Goward 2003, Lehmkuhl 2004, Goward and Campbell 2005, Velmala *et al.* 2009, Rambo 2012, Rambo and North 2012, McCune and Geiser 2014). It is rarely found on hardwood trees in North America. (Ryan 2002, McCune and Geiser 2014). *Picea abies* (Norway Pine) and *Pinus sylvestris* (Scots Pine) are the most common host tree species in Eurasia, though it has also been observed on deciduous taxa (Tarhanen *et al*. 2000, Velmala *et al*. 2009, Wirth *et al*. 2013, Tarasova *et al*. 2016). For example, the species has been reported from *Fraxinus* bark in the Republic of Karelia and Finland (Golubkova 1996). In North America, substrates include defoliated branches and twigs of a variety of coniferous tree species including *Abies concolor* var. *lowiana* (White Fir), *A. grandis* (Grand Fir), *A. lasiocarpa* (Subalpine Fir), *A. magnifica* (Red Fir), *Larix occidentalis* (Western Larch), *Picea engelmannii* (Engelmann Spruce), *Pinus albicaulis* (Whitebark Pine), *P. contorta* (Lodgepole Pine), *P. ponderosa* (Ponderosa Pine), and *Pseudotsuga menziesii* (Douglas Fir) (Turner 1977, Hayward and Rosentreter 1994, Eversman *et al*. 2002, Lehmkuhl 2004, Goward and Campbell 2005, Crawford 2007, Rambo 2012, Rambo and North 2012).

This species grows in well-ventilated areas within tree foliage and is most abundant in upper canopies of dense, old-growth forests and stands (Trass and Randlane 1994, Golubkova 1996, Goward 2003, Lehmkuhl 2004, Goward and Campbell 2005, Velmala *et al.* 2009, Rambo 2012). Adequate ventilation is necessary to create suitable microhabitats that promote growth and dispersal of *B. fremontii,* and is especially important to subpopulations in areas that experience prolonged snow cover (Velmala *et al.* 2009, Rambo 2012), as this species requires periodic drying (Goward and Campbell 2005, Crawford 2007). *Bryoria fremontii* is highly sensitive to changes in abiotic factors such as temperature and precipitation, making open microhabitats within tree canopies critical (Lehmkuhl 2004). Most growth occurs during wetter seasons and growth is likely faster in habitats with relatively high moisture availability, such as those near water bodies (Rambo and North 2012). This species appears to be most abundant in areas with precipitation in the form of snow for part of the year, cooler microhabitats near inland flowing water bodies, and hot summers followed by cold winters (Hayward and Rosentreter 1994, Eversman *et al.* 2002, Lehmkuhl 2004, Rambo and North 2012, Wirth *et al.* 2013). While it can also be common in more arid, mid-successional pine forests, it occurs at much lower abundances in these ecosystems (Lehmkuhl 2004, Goward and Campbell 2005, Velmala et al. 2009, Rambo 2012).


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*Bryoria fremontii* serves as a critical nesting and food resource for multiple vertebrate species, including Northern Flying Squirrels (*Glaucomys sabrinus*) and Douglas Squirrels (*Tamiasciurus douglasii*), which are important prey species for the California Spotted Owl (*Strix occidentalis ssp. occidentalis*), Northern Spotted Owl (*Strix occidentalis ssp. caulis*), Pine Marten (*Martes americana*), and American Fisher (*Martes pennanti*) (Hayward and Rosentreter 1994, Lehmkuhl 2004, Rambo 2012, Rambo and North 2012). In British Columbia, the recently endangered and highly fragmented Southern Mountain Caribou ecotype (*Rangifer tarandus ssp. caribou*) depends on this lichen as a primary winter food source (Goward 2003, Goward and Campbell 2005, USFWS 2019) and it is historically recognised as having been an alternative food source for other ungulates, including cattle (Turner 1977). Northern Flying Squirrels specifically select members of this species without vulpinic acid over other lichens, including other members of *Bryoria*, as the lack of toxic secondary compounds makes for nesting material that can also be fed on (Hayward and Rosentreter 1994, Goward 2003). It is thought that dependency on *B. fremontii* is strong enough to invoke fluctuations in these squirrel subpopulations (Hayward and Rosentreter 1994, Goward 2003).

**Systems:** Terrestrial

# Use and Trade

This species is a culturally important resource for indigenous peoples in British Columbia, Alberta, Washington, Montana, Idaho, Oregon, and northern California. Specific historical uses for and levels of dependency on *Bryoria fremontii* differ between groups, though its most common use is as a source of food (Turner 1977, Brodo *et al.* 2001, Crawford 2007). The chemotype lacking vulpinic acid and other secondary compounds that deter herbivory, as well as its availability above snowpack during winter months, makes *B. fremontii* a desirable resource over other lichen species, including other species of *Bryoria* (Turner 1977, Hayward and Rosentreter 1994, Brodo *et al.* 2001, Crawford 2007, Velmala *et al*. 2009, Lindgren *et al.* 2014). The carbohydrates found in this species are not digestible by humans; however, its filamentous nature absorbs starches from other foods it is cooked with and increases their nutritional value (Crawford 2007). *Bryoria fremontii* is also used to make clothing, as a yellow dye, and as medicine. For multiple indigenous groups, the species plays an important role in mythology and ceremonies, as it is told that *B. fremontii* originated when Coyote cut off his braid so that his people might be fed (Turner 1977, Brodo *et al.* 2001). Gathering for all known purposes has declined over time, and is not thought to have ever been conducted at a level that would substantially impact the population. It is still used casually, though it is no longer thought to be dependent upon for sustenance (Turner 1977, Brodo *et al.* 2001). More recently, the species has been used to monitor ecosystem health and animal foraging quality in many protected areas throughout its distribution, due to its climatic sensitivity and low level of pollution tolerance (Tarhanen *et al*. 2000, Eversman *et al.* 2002, Lehmkuhl 2004, Rambo 2012, Rambo and North 2012). In Europe, there are records of historical use for distilling alcohol and as livestock feed when other resources were scarce (Turner 1977).

## Threats (see Appendix for additional information)

Past, ongoing, and future threats to this species include habitat loss via the clearing of mid-successional and old-growth forests, urban and suburban development, high-intensity prescribed burns that destroy


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upper tree canopies, long-term fire suppression resulting in increased fire intensity, and climate change effects that increase the aridity of moist habitats to result in alterations of ecosystem structure, as well as increased fire frequency (Hayward and Rosentreter 1994, Eversman *et al.* 2002, Lehmkuhl 2004, Goward and Campbell 2005, Rambo and North 2012). For example, past misguided conservation management via fire suppression in Northern Spotted Owl habitats where *Bryoria fremontii* is present resulted in the accumulation of large fuel loads that increased the intensity of wildfires until controlled burns started being prescribed (Lehmkuhl 2004). Past and present collecting for human use is not thought to threaten the species or cause substantial declines (Crawford 2007). Likewise, its use by various mammal and bird species is not thought to be a threat, and might even facilitate population growth of *B. fremontii* via the dispersal of clonal fragments (Hayward and Rosentreter 1994). Members of *Bryoria* are recognised as being some of the most sensitive lichens to both air pollution and temperature changes, and both of these threats have the further potential to degrade suitable habitats for this species, including old-growth forests and protected areas (Tarhanen *et al*. 2000, Rambo 2012, Rambo and North 2012). Subpopulations inhabiting areas of the southern Sierra Nevada Range have long been threatened by air pollution produced from the Central Valley region of California (Rambo 2012). Despite the multitude of localised threats to this species, its broad distribution and large population size suggests that no substantial threats will endanger this species in the near future.

## Conservation Actions **(see Appendix for additional information)**

Protection of *Bryoria fremontii* and its habitat is recommended not just for the species itself, but also for the conservation of vertebrate species that depend on its use (Goward 2003, Goward and Campbell 2005, Rambo and North 2012). Forest thinning in areas hosting subpopulations of *B. fremontii* should aim to leave upper canopy foliage untouched and a substantial number of trees in clusters to maintain suitable habitat (Lehmkuhl 2004, Goward and Campbell 2005, Rambo and North 2012). Clearing trees near riparian zones should be avoided when possible (Lehmkuhl 2004). Burns prescribed in *B. fremontii* habitat should be of low intensity to conserve upper canopy microhabitats where this species is most abundant (Lehmkuhl 2004). Continued and additional protection of old-growth forests, as well as buffering such habitats from climate change effects are additional ways this species can be conserved (Eversman *et al.* 2002, Lehmkuhl 2004, Goward and Campbell 2005). *Bryoria fremontii* incidentally occurs in several protected areas.

# Credits

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|---|---|
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| **Partner(s) and Institution(s):** | ABQ Biopark |


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## Disclaimer

To make use of this information, please check the Terms of Use.

## External Resources

For Supplementary Material, and for Images and External Links to Additional Information, please see the Red List website.


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# Appendix

## Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

| Habitat | Season | Suitability | Major Importance? |
|---|---|---|---|
| 1. Forest -> 1.1. Forest - Boreal | Resident | Suitable | Yes |
| 1. Forest -> 1.2. Forest - Subarctic | Resident | Suitable | Yes |
| 1. Forest -> 1.4. Forest - Temperate | Resident | Suitable | Yes |

## Plant Growth Forms

(http://www.iucnredlist.org/technical-documents/classification-schemes)

| Plant Growth Form |
|---|
| LC. Lichen |
| E. Epiphyte |

## Use and Trade

(http://www.iucnredlist.org/technical-documents/classification-schemes)

| End Use | Local | National | International |
|---|---|---|---|
| Other chemicals | Yes | No | No |
| Other (free text) | No | Yes | No |
| Food - animal | Yes | No | No |
| Wearing apparel, accessories | Yes | No | No |
| Fibre | Yes | No | No |
| Medicine - human & veterinary | Yes | No | No |
| Food - human | Yes | No | No |

## Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

| Threat | Timing | Scope | Severity | Impact Score |
|---|---|---|---|---|
| 1. Residential & commercial development -> 1.1. Housing & urban areas | Ongoing | Minority (50%) | Slow, significant declines | Low impact: 5 |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion<br>2. Species Stresses -> 2.1. Species mortality | | |


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| | | | | |
|---|---|---|---|---|
| 5. Biological resource use -> 5.3. Logging & wood harvesting -> 5.3.4. Unintentional effects: (large scale) [harvest] | Ongoing | Minority (50%) | Slow, significant declines | Low impact: 5 |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion<br>1. Ecosystem stresses -> 1.2. Ecosystem degradation<br>2. Species Stresses -> 2.1. Species mortality | | |
| 7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.1. Increase in fire frequency/intensity | Ongoing | Minority (50%) | Causing/could cause fluctuations | Low impact: 5 |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion<br>1. Ecosystem stresses -> 1.2. Ecosystem degradation<br>2. Species Stresses -> 2.1. Species mortality | | |
| 7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.2. Supression in fire frequency/intensity | Ongoing | Minority (50%) | Unknown | Unknown |
| | Stresses: | 1. Ecosystem stresses -> 1.2. Ecosystem degradation<br>1. Ecosystem stresses -> 1.3. Indirect ecosystem effects | | |
| 9. Pollution -> 9.5. Air-borne pollutants -> 9.5.2. Smog | Ongoing | Minority (50%) | Slow, significant declines | Low impact: 5 |
| | Stresses: | 2. Species Stresses -> 2.1. Species mortality | | |
| 11. Climate change & severe weather -> 11.1. Habitat shifting & alteration | Future | Unknown | Slow, significant declines | Unknown |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion | | |
| 11. Climate change & severe weather -> 11.2. Droughts | Future | Unknown | Slow, significant declines | Unknown |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion<br>2. Species Stresses -> 2.1. Species mortality | | |
| 11. Climate change & severe weather -> 11.3. Temperature extremes | Future | Unknown | Slow, significant declines | Unknown |
| | Stresses: | 1. Ecosystem stresses -> 1.1. Ecosystem conversion<br>2. Species Stresses -> 2.1. Species mortality | | |

# Conservation Actions in Place

**(http://www.iucnredlist.org/technical-documents/classification-schemes)**

| **Conservation Action in Place** |
|---|
| In-place research and monitoring |
| Action Recovery Plan: No |
| Systematic monitoring scheme: No |
| In-place land/water protection |
| Conservation sites identified: No |
| Occurs in at least one protected area: Yes |
| In-place education |
| Subject to recent education and awareness programmes: No |

## Conservation Actions Needed

**(http://www.iucnredlist.org/technical-documents/classification-schemes)**

| Conservation Action Needed |
|---|
| 1. Land/water protection -> 1.1. Site/area protection |
| 1. Land/water protection -> 1.2. Resource & habitat protection |
| 2. Land/water management -> 2.3. Habitat & natural process restoration |
| 4. Education & awareness -> 4.3. Awareness & communications |

## Research Needed

**(http://www.iucnredlist.org/technical-documents/classification-schemes)**

| Research Needed |
|---|
| 1. Research -> 1.2. Population size, distribution & trends |
| 1. Research -> 1.3. Life history & ecology |
| 1. Research -> 1.5. Threats |
| 2. Conservation Planning -> 2.2. Area-based Management Plan |

## Additional Data Fields

| Distribution |
|---|
| Continuing decline in area of occupancy (AOO): Unknown |
| Extreme fluctuations in area of occupancy (AOO): No |
| Estimated extent of occurrence (EOO) ($km^2$): 15500000 |
| Continuing decline in extent of occurrence (EOO): Unknown |
| Extreme fluctuations in extent of occurrence (EOO): No |
| Continuing decline in number of locations: Unknown |
| Extreme fluctuations in the number of locations: No |
| Upper elevation limit (m): 4,600 |
| **Population** |
| Continuing decline of mature individuals: Unknown |
| Extreme fluctuations: No |
| Population severely fragmented: No |
| Continuing decline in subpopulations: Unknown |
| Extreme fluctuations in subpopulations: No |


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| **Population** |
| --- |
| All individuals in one subpopulation: No |
| **Habitats and Ecology** |
| Continuing decline in area, extent and/or quality of habitat: Unknown |

# The IUCN Red List Partnership


The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: Arizona State University; BirdLife International; Botanic Gardens Conservation International; Conservation International; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; and Zoological Society of London.