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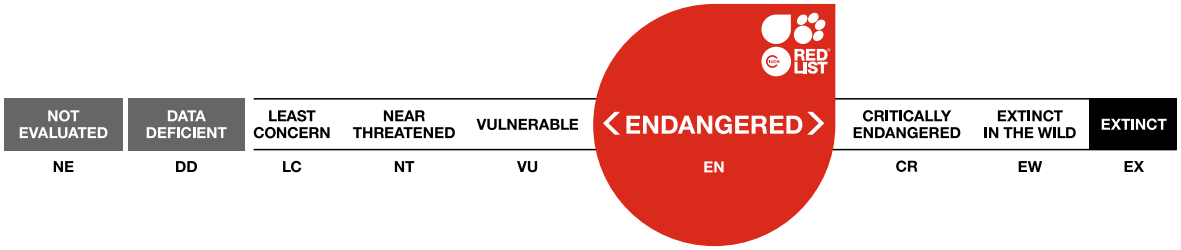
Language: English

Texosporium sancti-jacobi, Woven-spore Lichen

Assessment by: Stone, D., Root, H., Hollinger, J., Rosentreter, R., Chandler, A. & Allen, J.



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Taxonomy

Kingdom	Phylum	Class	Order	Family
Fungi	Ascomycota	Lecanoromycetes	Caliciales	Caliciaceae

Scientific Name: *Texosporium sancti-jacobi* (Tuck.) Nádv.

Synonym(s):

- *Acolium sancti-jacobi* Tuck.
- *Cyphelium sancti-jacobi* (Tuck.) Zahlbr.

Common Name(s):

- English: Woven-spore Lichen

Assessment Information

Red List Category & Criteria: Endangered B2ab(ii,iii,iv,v) ver 3.1

Year Published: 2020

Date Assessed: August 6, 2020

Justification:

Texosporium sancti-jacobi is a distinctive, late succession, soil-dwelling species endemic to arid regions of the western United States of America. Numerous threats have led to reduction in its habitat quality and extent of occurrence, area of occupancy, and the number of mature individuals. While its extent of occurrence is large, its area of occupancy is small (minimum AOO = 356 km^2). Therefore, it is listed as Endangered, B2ab(ii,iii,iv,v).

Geographic Range

Range Description:

Texosporium sancti-jacobi occurs at scattered sites throughout the arid western United States of America, and is found in California, Oregon, Washington, Idaho, and Montana.

Country Occurrence:

Native, Extant (resident): United States (California, Idaho, Montana, Oregon, Washington)

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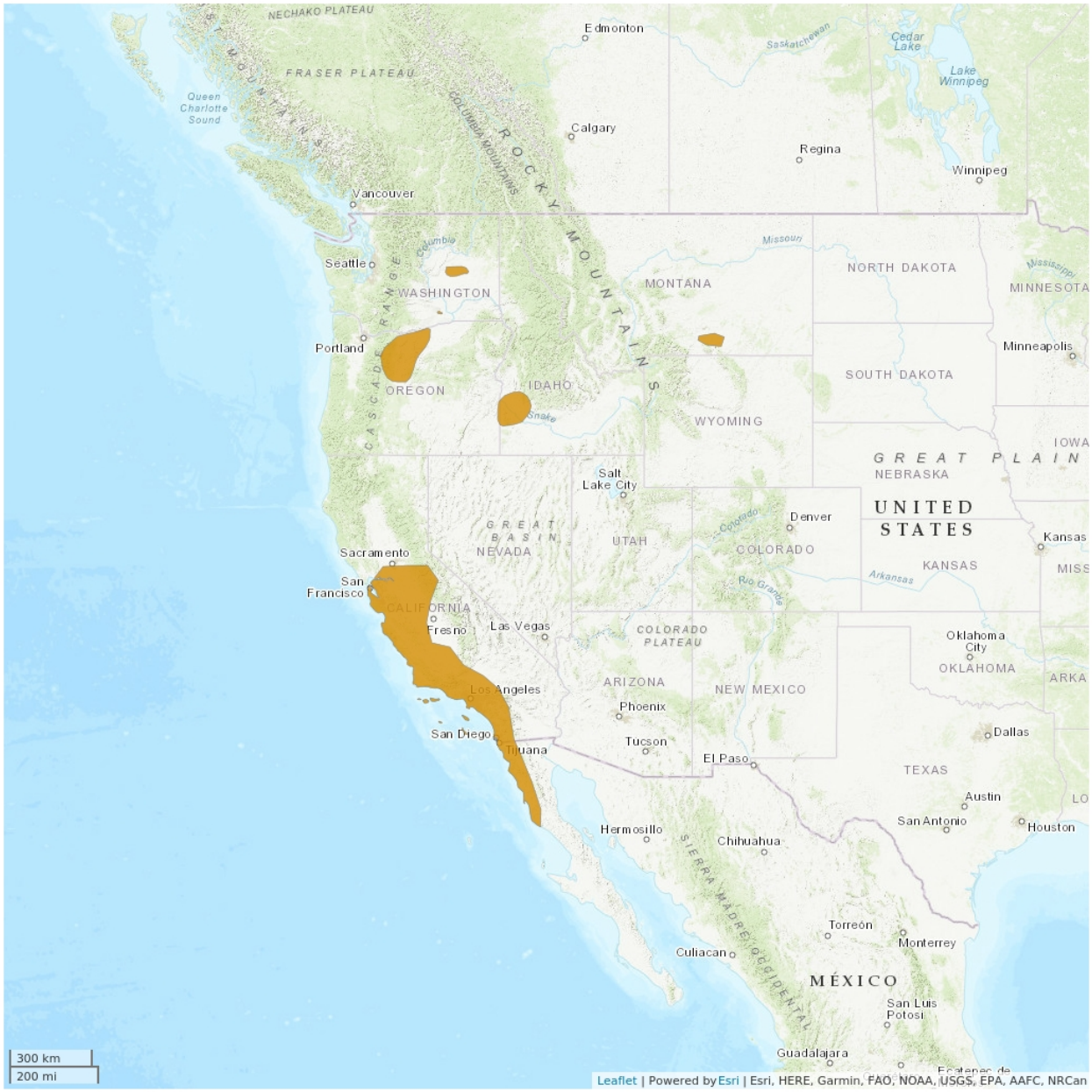
Distribution Map



Legend

EXTANT (RESIDENT)

Compiled by:

IUCN (International Union for Conservation of Nature) 2020

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

The total number of mature individuals of this species is estimated to be declining based on repeated visits by experts to subpopulations where there is a clear decline in robust thalli (Stone *et al.* 2018), and the documented extirpation of eight total locations, four in Idaho and four in Washington. The population reduction conclusion is also based on modelling that suggests >75% of its potential habitat in parts of its range is now occupied by development and agricultural activities (Root *et al.* 2011). The expansion of agriculture and development in this region has occurred rapidly over the past 100 years, and is ongoing. Multiple known subpopulation locations of *Texosporium sancti-jacobi* have been extirpated by grazing, road construction, and high-intensity fires (Observations made by R. Rosentreter, D. Stone, H. Root, and A. Hardman). In Washington state, grazing has had a significant impact on multiple locations, though no baseline demographic data exists to facilitate formal quantification of these effects (Observations made by D. Stone). However, specialists have observed that sites that have been ungrazed and unburned for 20+ years are occupied by individuals with larger thalli than were observed at grazed sites (Stone *et al.* 2018). In Idaho, four known locations have been extirpated by the combination of grazing and fire (personal observation R. Rosentreter). These sites are all in Ada County and all in the same grazing allotment, specifically. Given the specific climatic and soil type requirements of this species, *T. sancti-jacobi* likely naturally always exhibited a somewhat scattered distribution pattern. The destruction of much of its habitat by human forces has now led to the species being severely fragmented throughout its range.

Current Population Trend: Decreasing

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

Texosporium sancti-jacobi can be found in semi-arid to arid habitats, including shrub-steppe, chaparral, grasslands, old growth sagebrush-steppe, and biscuit scablands (Stone *et al.* 2018). It often grows on lithosols, where rock cobble protects thalli from grazing both physically and by deterring livestock activity due to lack of vegetation able to grow in such soils (Stone *et al.* 2018). Rocky areas are also avoided by livestock because the rocks hurt their feet. A model of the species' suitable habitat found that it was strongly associated with silty and rocky soil and warm, dry parts of the region (Root *et al.* 2011). This species is also found on decaying bunchgrass and organic matter and is typically found in places retaining native vegetation (Reifner and Rosentreter 2004, McCune and Rosentreter 2007). Biological soil crusts such as *T. sancti-jacobi* are extremely important to desert ecosystems, given they decrease erosion via the binding of soil particles as thalli formation and rhizine establishment occurs, increase water retention in dry soils, and alter soil temperatures to allow continued succession of vascular plant communities (Kaltenecker *et al.* 1999, Muscha and Hild 2006, Jiménez-Aguilar *et al.*2009, Concostrina-Zubiri *et al.* 2014, Tabeni *et al.* 2014, Root and Dodson 2016, RMRS 2017).

Systems: Terrestrial

Threats **(see Appendix for additional information)**

The most severe threats to this species, along with many other biological soil crust (BSC) species, are grazing activity, fire, urban and suburban development, agricultural practices, spatial competition with the invasive species cheatgrass (*Bromus tectorum*), misguided restoration activities, recreation, and fuel breaks (Root and Dodson 2016, Stone *et al.* 2018, Root *et al*. 2019). A detailed study of potential distribution of *Texosporium sancti-jacobi* in Oregon found that >75% of its potentially suitable habitat is

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now occupied by agriculture and development (Root *et al.* 2011).

BSC communities exhibit highest diversity in semi-arid to arid shrublands and grasslands hosting native vascular plant species in scattered, low-density cover (Muscha and Hild 2006, Tabeni *et al.* 2014). Coincidentally, these habitats are also ideal for livestock grazing with associated trampling that poses a direct threat to BSC communities (Muscha and Hild 2006, Dettweiler-Robinson *et al*. 2013). Other causes of disturbance, including a multitude of combined biotic and abiotic factors, worsen or buffer effects of grazing and determine the length of recovery time for a specific soil crust community following grazing cessation (Warren and Eldrigde 2001, Dettweiler-Robinson *et al.* 2013, Concostrina-Zubiri *et al.* 2014). Even a general idea regarding recovery time for lichen species following a grazing event is unpredictable, as this is dependent on a wide and complex variety of interrelated factors including climate (i.e. temperature and precipitation), soil characteristics, herbivory-induced evolutionary responses, vascular plant density and community structure, elevation, and amount of disturbance imposed (Muscha and Hild 2006, Dettweiler-Robinson *et al.* 2013, Concostrina-Zubiri *et al.* 2014). More northern habitats are likely at increased risk from grazing when considering climatic differences that increase the amount of recovery time in such regions (Muscha and Hild 2006). Grazing during times of the year when precipitation (and therefore soil moisture) is lowest appears to have a greater impact on BSC species than does grazing during wetter seasons, when lichen thalli are less prone to breakage (Kaltenecker *et al.* 1999, Warren and Eldridge 2001, Muscha and Hild 2006, Dettweiler-Robinson *et al.* 2013, Concostrina-Zubiri *et al.* 2014, RMRS 2017).

The ambiguity and need for more research surrounding grazing effects on soil-dwelling lichens such as *T. sancti-jacobi* makes it extremely difficult to predict recovery time from grazing for even one disturbed location, much less for the population as a whole (Concostrina-Zubiri *et al.* 2014). Observations from specialists and studies have found *T. sancti-jacobi* to be less resilient to disturbance and to have a slower recovery time relative to many other BSC-forming lichen species, as it is not found on recently disturbed soils. More recent research suggests that grazing impacts can prevent disturbed habitats from ever returning to their original state due to changes in vegetative community composition that alter the types and number of specific microhabitats available and, therefore, species compositions (Kaltenecker *et al.* 1999, Dettweiler-Robinson *et al.* 2013, Concostrina-Zubiri *et al.* 2014, Condon *et al.* 2019). Part of this ecosystem conversion is due to invasive vascular plant species, especially grasses, that colonise quickly following grazing and can compete spatially with BSC species and grow at a much faster rate compared to all soil crust lichen species (Warren and Eldridge 2001, Tabeni *et al.* 2014, Condon *et al*. 2019). Given all of this information, there is a chance *T. sancti-jacobi* might never become re-established at sites where it has been locally extirpated due to grazing activity, regardless of any protection and/or restoration efforts made (Condon *et al.* 2019).

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

Grazing during times of the year when precipitation (and therefore soil moisture) is lowest appears to have a greater impact on biological soil crusts than does grazing during wetter seasons when crusts are less prone to breakage (Kaltenecker et al. 1999, Warren and Eldridge 2001, Muscha and Hild 2006, Concostrina-Zubiri *et al.* 2014, Condon *et al.* 2019). For this reason, it is recommended that conservation measures should aim to, at the very least, limit grazing activity in suitable and known habitats of *T. sancti-jacobi* to wetter seasons (Warren and Eldridge 2001, Concostrina-Zubiri *et al.* 2014, RMRS 2017). Other recommendations for general conservation include limiting grazing activity on leased properties and terminating leases where subpopulations are in decline, and continuing to keep Bureau of Land

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Management land that is historically free of grazing activity or that hasn't been grazed in at least 20 years from being opened up to these threats. In following suit with these recommendations, livestock troughs (feed, salt, and water) should not be placed within one mile of known sites of this species to deter livestock movement in the vicinity of this species.

Texosporium sancti-jacobi is listed as G3/N3 by the Interagency Special Status/Sensitive Species Program (ISSSSP). It is also classified as sensitive in Oregon and is a federal species of concern in Washington State. NatureServe considers it to be critically endangered in California and Washington, as well as imperiled in Oregon and Idaho. While the species occurs in at least one protected area, it is recommended that more habitat be preserved and educational information be provided to communities where this species still occurs (Condon *et al.* 2019).

Credits

Assessor(s): Stone, D., Root, H., Hollinger, J., Rosentreter, R., Chandler, A. & Allen, J.

Reviewer(s): Lendemer, J.

Facilitator(s) and Compiler(s): Allen, J. & Chandler, A.

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Disclaimer

External Resources

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

Appendix

Habitats

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

Habitat	Season	Suitability	Major Importance?
3. Shrubland -> 3.4. Shrubland - Temperate	Resident	Suitable	Yes
4. Grassland -> 4.4. Grassland - Temperate	Resident	Suitable	Yes
8. Desert -> 8.2. Desert - Temperate	Resident	Suitable	Yes

Plant Growth Forms

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

Plant Growth Form
M. Fungus
LC. Lichen

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	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		
2. Agriculture & aquaculture -> 2.1. Annual & perennial non-timber crops -> 2.1.3. Agro-industry farming	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 2. Species Stresses -> 2.1. Species mortality		
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.1. Nomadic grazing	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		
2. Agriculture & aquaculture -> 2.3. Livestock farming & ranching -> 2.3.3. Agro-industry grazing, ranching or farming	Ongoing	Majority (50-90%)	Rapid declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		
4. Transportation & service corridors -> 4.1. Roads & railroads	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion		

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		2. Species Stresses -> 2.1. Species mortality		
6. Human intrusions & disturbance -> 6.1. Recreational activities	Ongoing	Minority (50%)	Slow, significant declines	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 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	Whole (>90%)	Slow, significant declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		
8. Invasive and other problematic species, genes & diseases -> 8.1. Invasive non-native/alien species/diseases -> 8.1.2. Named species (Bromus tectorum)	Ongoing	Whole (>90%)	Slow, significant declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.1. Nutrient loads	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation		
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.2. Soil erosion, sedimentation	Ongoing	Whole (>90%)	Slow, significant declines	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 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: Yes, over entire range
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 -> 2.2. Invasive/problematic species control
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
3. Monitoring -> 3.1. Population trends

Additional Data Fields

Distribution
Estimated area of occupancy (AOO) (km²): 356-436
Continuing decline in area of occupancy (AOO): Yes
Extreme fluctuations in area of occupancy (AOO): No
Estimated extent of occurrence (EOO) (km²): 1372095
Continuing decline in extent of occurrence (EOO): Unknown
Extreme fluctuations in extent of occurrence (EOO): No
Number of Locations: 44-64
Continuing decline in number of locations: Yes
Extreme fluctuations in the number of locations: No
Population
Continuing decline of mature individuals: Yes
Extreme fluctuations: No
Population severely fragmented: Yes
Continuing decline in subpopulations: Unknown

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Population
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
Habitats and Ecology
Continuing decline in area, extent and/or quality of habitat: Yes

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.