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5- Year Review Short Form

Species Reviewed: Holmgren milkvetch (*Astragalus holmgreniorum*)

Federal Register Notice Announcing Initiation of this Review: May 27, 2016. Endangered and threatened wildlife and plants; 5-year status reviews of 21 species in the Mountain Prairie Region (84 FR 33698).

Current Classification: Endangered

Current Recovery Priority Number: 5C

This recovery priority number is indicative of a species with a high degree of threat, imminent conflicts with land development, and a relatively low potential for recovery.

Methodology used to complete this review:

This review was completed by the Utah Ecological Services Field Office on July 21, 2021. All pertinent literature and documents on file at the Utah Ecological Services Field Office were used for this review, including new information obtained since the last status review (Service 2007). New information for Holmgren milkvetch is summarized in the Appendix.

Review Summary:

Holmgren milkvetch is a member of the pea family (Fabaceae or Leguminosae) and is endemic to the Mojave Desert in limited areas of Washington County, Utah and Mohave County, Arizona. Plants are spring ephemerals that produce leaves and small purple flowers in the spring and enter dormancy after the flowering season (June to February) (Rominger et al. 2019a). Plants are generally short-lived (less than 3 years) with low survivorship (Van Buren et al. 2021). The average survival of seedlings through the first-year dormant season (summer) is 16 percent, ranging from zero to 45 percent annually (Meyer et al. 2018).

Holmgren milkvetch has an unusual life history strategy compared to most plants in the Mojave Desert. The species' meristems (growing tips of shoots and roots) are located at the ground surface and are subject to much hotter soil temperatures than other plants with buried meristems (Van Buren et al. 2021). As a result, the species experiences high dormant-season mortality from summer temperatures. To persist, Holmgren milkvetch relies on its seedbank and high levels of reproduction in years of favorable precipitation to replenish the seedbank (Searle 2011; Van Buren et al. 2021). Populations that do not achieve high plant reproduction in favorable years may become seed limited and have a higher risk of extinction. Habitat topography plays an important role for Holmgren milkvetch by providing overland flow of precipitation to support seedling recruitment and adult plant reproduction (Meyer et al. 2020). Larger topographic features have larger watershed areas that provide more overland flow to Holmgren milkvetch plants located along their toe slopes. The two largest Holmgren milkvetch populations (State Line and Central Valley) contain the largest topographic

features (mesas, ridge remnants, fan terraces, and steep swales) to provide overland flow of precipitation while the small populations contain smaller topographic features.

Holmgren milkvetch is primarily pollinated by solitary bees, but their flowers attract a range of visitors that include hawkmoths, hummingbirds, and nectar-robbing wasps (Tepedino 2005; Pavlik and Barlow 2017). The main pollinator is a large, solitary bee, Porter's Digger Bee (*Anthophora porterae*), which prefers plants in the pea family and appears to rely primarily on Holmgren milkvetch for its dietary needs (Pavlik and Barlow 2017). The species is generally associated with the Virgin Limestone member of the Moenkopi Formation and less commonly with the Petrified Forest member of the Chinle formation. Associated native plant species include perennial shrubs such as Nevada Mormon tea (*Ephedra nevadensis*), burrobush (*Ambrosia salsola*), Anderson wolfberry (*Lycium andersonii*), and the perennial grass big galleta (*Pleuraphis rigida*) (Meyer et al. 2018). Holmgren milkvetch occupies a very small portion of the range of the Mojave desert tortoise in Washington County, Utah and Mohave County, Arizona due to its highly specific soil and moisture requirements (USFWS 2006, 2011b).

We listed Holmgren milkvetch as endangered in 2001 (66 FR 49560, September 28, 2001) under the Endangered Species Act of 1973 (Act), as amended (56 FR 56882). The estimated total population size at that time was 10,030 to 11,030 plants in three populations and the primary threats were urban development, recreation, livestock grazing, and nonnative plants (USFWS 2001). In 2006, we designated critical habitat (71 FR 77972, December 27, 2006) and completed a final recovery plan (USFWS 2006). In the recovery plan, we revised our initial three population delineation into six recovery populations based on NatureServe criteria (NatureServe 2004; USFWS 2006).

We now know of seven geographically discrete Holmgren milkvetch populations on Federal (Bureau of Land Management (BLM)), state, and private lands. The seventh population (Green Valley) is on private lands along a utility corridor outside of designated critical habitat (McCormick and Wheeler 2018). We estimate 7,100 adult plants occur range wide, with 56 percent occurring in the State Line population on BLM land, 42 percent occurring in the Central Valley population on state land, and two percent occurring in the five remaining populations. The current estimate of 7,100 individuals (adult plants) is lower than the 2001 and 2006 estimates due to declining population trends on BLM lands within four populations (State Line, Purgatory Flat, South Hills, and Stucki Springs) as well as some loss of plants to development on state and private lands (Van Buren et al. 2016; Lewinsohn 2021). In the smallest three Holmgren milkvetch populations (South Hills, Stucki Springs, and Purgatory Flat), plant abundance has declined, and surveys detected few to no plants in recent years. The decline in the State Line population appears to be the result of threats (livestock grazing, nonnative weeds, and recreation) acting on the species, singly or in combination (Van Buren et al. 2016; Searle and Meyer 2020). The decline in the three smaller populations (Purgatory Flat, South Hills, and Stucki Springs) appears to be the result of threats (nonnative weeds) in combination with seed limitation. Container seed production and seed salvage efforts on state lands support the current population augmentation and introduction efforts on BLM and The Nature Conservancy (TNC) lands intended to improve population size and trends (Schultz and Meyer 2015; Meyer et al. 2017, 2018, 2020; Rominger et al. 2019b; Schultz et al. 2021).

The threats to Holmgren milkvetch have not changed since listing. Urban development continues to be a primary threat to the species on state and private lands. In Washington County, Utah, approximately 1,000 Holmgren milkvetch plants were lost to development in the State Line and Central Valley populations (Lewinsohn 2021). However, we expect additional habitat protections planned for the

State Line and Central Valley populations to reduce additional losses from development (see Appendix, Recovery Action 1). After accounting for planned habitat protections, we estimate the future loss of an additional 1,000 to 1,500 plants in two populations (Central Valley and Green Valley) on non-Federal lands in Washington County (USFWS 2021) due to urban development in the absence of additional conservation action.

Recreation, specifically from off-highway vehicle (OHV) use, results in habitat degradation, increased erosion, and may facilitate the spread and establishment of nonnative plants (USFWS 2006). At the time of listing, all six populations were accessible to recreational use. Since that time, BLM fenced the entire South Hills population, their lands within the Purgatory population, and partially fenced the Stucki Springs population. Additionally, the State of Utah Institutional Trust Lands Administration (SITLA) fenced the remaining undeveloped portion of the Central Valley population. Recreation and OHV use continue occur within the State Line, Stucki Springs, and Gardner Well populations on BLM lands and the Green Valley population on private lands. User created trails through occupied habitat are a problem despite the BLM restricting use to existing roads and trails (BLM 2016). The BLM St. George office is currently developing a travel management plan to designate roads and trails and identify appropriate use and restrictions which would apply to four (State Line, South Hills, Stucki Springs, Purgatory) of the seven Holmgren milkvetch populations (Taylor 2021).

Livestock trampling in the largest population (State Line) results in the death of dormant plants (June to February) and is strongly correlated with the amount of trampling disturbance (Searle and Meyer 2020). Livestock grazing may also facilitate the spread and establishment of nonnative plants. The threat posed by nonnative plants continues to increase as weed cover increases within Holmgren milkvetch populations (Rominger et al 2019b). Cheatgrass (*Bromus tectorum*) and red brome (*B. rubens*) in particular compete with Holmgren milkvetch for water and nutrients in wet years (2005 and 2011) and appear to negatively affect Holmgren milkvetch seedling recruitment and adult plant seed production (Van Buren et al. 2016; Rominger et al 2019b; Meyer et al. 2020). Holmgren milkvetch seedling recruitment in the large State Line population is apparently no longer responding to favorable spring moisture conditions. This appears to be the result of threats (livestock grazing, nonnative weeds, and recreation) acting on the species, singly or in combination (Van Buren et al. 2016; Searle and Meyer 2020).

We designated approximately 6,289 acres of critical habitat in Washington County, Utah and Mohave County, Arizona (71 FR 77972, December 27, 2006). This coincided with the 6 known populations at the time (State Line, Central Valley, Stucki Springs, South Hills, Purgatory Flat, and Gardner Well) in Arizona and Utah. To date, development has resulted in the loss of approximately 497 acres of critical habitat in the State Line (subunit 1a), Central Valley (subunit 1c), and Purgatory Flat (Unit 3)) populations (Lewinsohn 2021). Approximately 166 acres of critical habitat in the State Line (subunit 1) population will be transferred to Federal ownership in 2021 as part of the Utah Test and Training Range legislation (Public Law 114-328) (Appendix 1; Roe 2020). Approximately 200 to 300 acres of critical habitat in the Central Valley (subunit 1c) population will be protected in-perpetuity as part of the commitments identified in the Washington County Habitat Conservation Plan (Appendix 1; Washington County Commission 2020).

Recommendations on species status:

After reviewing the best available scientific information and recovery criteria, we conclude that Holmgren milkvetch remains an endangered species. Our review of new information compiled since

2007 does not change our evaluation of the species status and threats affecting the species under the factors in 4(a)(1) of the Act from our most recent 5-year review (USFWS 2007). The downlisting and delisting criteria for Holmgren milkvetch are not met (USFWS 2006). Therefore, we recommend no change in status to the species at this time.

Recommended future actions:

Based on recent discussions with conservation partners, we recommend the following future actions: (1) work with partners to develop conservation and management agreements that provide long-term protections for the Central Valley population; (2) develop appropriate grazing management actions and adaptive management plans for the State Line population location to reduce livestock trampling effects to the species; (3) implement pilot fall herbicide treatments to control cheatgrass and red brome on BLM and TNC lands at the State Line and Purgatory Flat populations; (4) develop appropriate travel management plans and restrictions for the State Line population; (5) continue to augment declining BLM populations; (6) establish new populations to meet recovery goals; and (7) develop a local greenhouse propagation program to increase seed collections for population augmentation efforts.

YVETTE CONVERSE

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Yvette Converse, Field Supervisor
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APPENDIX

New information for Holmgren milkvetch since 2007 is summarized here by recovery action.

Recovery Action 1: Conserve populations and habitat

- The Bureau of Land Management (BLM) designated two new Areas of Critical Environmental Concern (ACECs) (South Hills and State Line) containing Holmgren milkvetch designated critical habitat (BLM 2016). (Recovery Action 1.4)
- The State of Utah Institutional Trust Lands Administration (SITLA) will transfer to the BLM approximately 166 acres of Holmgren milkvetch critical habitat in the State Line population (BLM 2020). This commitment protects the natural hydrologic regime of Atkinville Wash (Service 2019). The land exchange is in progress and will likely be completed by December 2021. (Recovery Action 1.1)
- SITLA committed to protect additional critical habitat (200 to 300 acres) in the Central Valley population and transfer to a conservation entity for in-perpetuity protection and management (Service 2021). This commitment greatly expands the amount of protected critical habitat in the Central Valley population; currently 17 acres is protected in this population. We, SITLA, and other conservation partners are working to finalize the details of the conservation area boundary and long-term management. (Recovery Action 1.1)

Recovery Action 2: Locate and conserve additional populations

- A new population of Holmgren milkvetch (Green Valley population) was found on private lands with an estimated 300 plants (McCormick and Wheeler 2018). The population is within a powerline right of way (ROW) and receives occasional maintenance and some recreational use. (Recovery Action 2.2)
- A suitable habitat model was developed to locate new populations (Young 2015). (Recovery Action 2.2)
- Detailed habitat mapping was performed using on-the-ground plant community characterization and drone imagery to identify associated plant species and improve the habitat suitability model (Meyer et al. 2018). Plant species associated with Holmgren milkvetch habitat are Nevada Mormon tea (*Ephedra nevadensis*), burrobush (*Ambrosia salsola*), Anderson wolfberry (*Lycium andersonii*), and big galleta (*Pleuraphis rigida*). A map delineating areas of creosote bush and petrophile (bedrock-associated) plant communities at the State Line population was developed to exclude these areas from a habitat suitability model. (Recovery Action 2.2).

Recovery Action 3: Monitor locations for population information and trends

- New Holmgren milkvetch monitoring protocols were developed for BLM lands (Meyer et al. 2019; Meyer et al. 2020). Six long-term monitoring plots were established to monitor Holmgren milkvetch density and demography, shrub density, and vegetative cover of the shrubs, understory plants, and nonnative plants. Vegetative cover data is collected using drone imagery. (Recovery Actions 3.1, 3.2)

- The State Line population maintained a similar distribution between 2008 and 2017 indicating that Holmgren milkvetch is not expanding or contracting within the critical habitat unit (Meyer et al. 2017). (Recovery Action 3.2)
- The State Line population may be in decline based on an evaluation of long-term monitoring data (1996 to 2016) likely due to multiple sources of disturbance (livestock grazing, recreation, non-native plants) (Rominger et al. 2019b). There was a significant downward trend in seedling recruitment during wet years. (Recovery Actions 3.1, 3.2)

Recovery Action 4: Establish a set of need-based research priorities aimed at abating or reducing threats and increasing population health and numbers

- Holmgren milkvetch's phenology and life history strategy were evaluated in more detail than previous studies. Holmgren milkvetch is a perennial, spring ephemeral which is a rare life history strategy for the Mojave Desert (Meyer et al. 2017; Rominger et al. 2019a). Temperature influenced the timing of emergence and dormancy induction and release, while precipitation influenced seedling emergence and survival, and plant growth and reproduction. (Recovery Action 4.1)
- Population dynamics and viability were evaluated with stochastic matrix models (Van Buren et al. 2021). The species' life history strategy has a high extinction risk that can be reduced by maintaining a large population size and augmenting populations with seeds. Holmgren milkvetch populations rely on regular contributions to the seedbank for persistence. Populations that do not achieve high plant reproduction in favorable years may become seed limited and have a higher risk of extinction. (Searle 2011; Meyer et al. 2015; Van Buren et al. 2021). (Recovery Action 4.4.8)
- Seed collections from the Central Valley population indicated that seed production and seed quality were much lower in the northern part of the population that has a greater level surface disturbance than the rest of the population in 2015, a year with average precipitation (Schultz and Meyer 2015). There was no difference in seed production between areas within the population in 2017, a high-precipitation year (Barlow and Pavlik 2017). (Recovery Actions 4.1, 4.4.3)
- Seedling emergence and establishment and one-year survival were evaluated (Meyer et al. 2018). Recruitment from planted scarified seeds at five field plots in 2017 ranged from 22 to 45 percent, and one-year survival ranged from 11 to 32 percent. Planting unscarified seeds is the recommended method for population introduction and augmentation efforts. Favorable results were achieved by broadcast seeding and raking methods. (Meyer et al. 2018). (Recovery Actions 4.4.3, 4.4.9)
- Seed dispersal mechanisms were investigated. Seeds are primarily dispersed by wind over short distances (up to 13 feet (ft)) and occasionally by water or Merriam's kangaroo rats over longer distances (up to 330 ft) Seeds may be dispersed up to 328 feet (100 meters) from the parent plant by these dispersal mechanisms. (Meyer et al. 2018; Houghton et al. 2020). (Recovery Action 4.4.9)
- The species' pollinators were evaluated in three populations (State Line, Central Valley, Gardner Well) using an automated monitoring system called Rana that recorded flower visitors. The primary visitor and pollinator is a large solitary bee, Porter's Digger Bee (*Anthophora porterae*) which likely nests in the ground. Hawkmoths, hummingbirds, and nectar-robbing wasps (*Odynerus cinnabarinus*) were other flower visitors. (Tepedino 2005; Barlow and Pavlik 2017). (Recovery Action 4.4.2)
- Long-term monitoring (1998 to 2018) indicated that weed cover has increased in the Holmgren milkvetch State Line population (Van Buren et al. 2016; Rominger et al 2019b). Cheatgrass

(*Bromus tectorum*) and red brome (*B. rubens*) cover sharply increased in recent wet years (2005 and 2011). Subsequently, the increase in cheatgrass and red brome cover appeared to negatively affect Holmgren milkvetch seedling recruitment which was lower than expected in those years. More recent monitoring indicated that cheatgrass and red brome appear to negatively affect Holmgren milkvetch seedling recruitment and adult plant seed production (Van Buren et al. 2016; Meyer et al. 2020). Pilot fall herbicide treatments are recommended to control cheatgrass and red brome in Holmgren milkvetch habitat. (Recovery Action 4.4.1)

- The effects of livestock trampling were investigated (Rominger et al 2019b; Searle and Meyer 2020). Livestock trampling negatively affected survival of dormant plants in the fall and winter months. The dormant meristems (contains stem and root tissue) located at or near the ground surface and are vulnerable to trampling. Plant mortality was strongly correlated with the level of trampling disturbance. Grazing management actions are recommended to disperse cattle (locate salt licks and water tanks outside of habitat) and reduce trampling intensity. (Recovery Action 4.4.9 to support Recovery Action 1.3)

<u>Recovery Action 5: Develop and implement a range-wide strategy for augmentation and/or introduction of populations</u>

- Successful greenhouse propagation methods were developed that resulted in high seed germination (60 percent), high plant survival (99 percent), and high seed production (average of 377 seeds per plant) with hand pollination (Meyer et al. 2017; Schultz et al. 2021). Container seed production can be used to augment declining populations, and local growing facilities are needed so that flowering coincides with pollinator availability. (Recovery Action 5.2)
- A genetic evaluation of Holmgren milkvetch populations indicated that recent gene flow occurred among populations and no populations suffered from genetic bottlenecks[1] or inbreeding depression[2] (Meyer et al. 2017). Two small populations (Purgatory, South Hills) have reduced genetic diversity due to loss of alleles (Young and King 2011). (Recovery Action 5.2)
- There are no concerns of outbreeding depression[3] by using seed sources from other populations for augmentation efforts (Meyer et al. 2017). (Recovery Action 5.2)
- Pilot augmentation efforts were performed on BLM and TNC lands at three populations (State Line, Purgatory, South Hills) in 2016 (Meyer et al. 2017; Meyer et al. 2018). (Recovery Actions 5.1, 5.2, 5.3)
- Augmentation efforts were expanded on BLM lands at the State Line population in 2017 and the Purgatory and South Hills populations in 2018 (Meyer et al. 2018; Meyer et al. 2020). (Recovery Actions 5.1, 5.2, 5.3)
- Pilot introduction efforts were initiated on BLM lands in 2018 and 2020 (Meyer et al. 2020). Habitat topography was evaluated at introduction plots and plays an important role in providing overland flow of precipitation to support seedling recruitment and adult plant reproduction. (Recovery Actions 5.1, 5.2, 5.3)

[1] Genetic bottlenecks occur when the size of a population is severely reduced for at least one generation and can have large effects on genetic variation and the potential survival of a species (Nature Education 2014).
[2] Inbreeding depression is the reduction in biological fitness of a population from inbreeding, the breeding of related individuals, that may result in unfit or fewer individuals in the next generation (Wikipedia 2021a).
[3] Outbreeding depression is the reduction in biological fitness of a population from outbreeding, the breeding of two genetically distant populations, that may result in unfit or fewer individuals in the next generation (Wikipedia 2021b).