

Fassett's Locoweed
(Oxytropis campestris var. chartacea)

**Status Review:
Summary and Evaluation**



Photo by: Joel Trick, USFWS

**U.S. Fish and Wildlife Service
Minnesota-Wisconsin Ecological Services (ES) Field Office
Bloomington, MN
2021**

STATUS REVIEW
Fassett's Locoweed (*Oxytropis campestris* var. *chartacea*)

GENERAL INFORMATION

Species: Fassett's locoweed

Date of listing publication: September 28, 1988

FR citation(s): 53 FR 37970-37972

Classification: Threatened

Reviewers: Jill Utrup, Minnesota/Wisconsin Field Office, 952-252-0092 ext. 207

Lead Regional Office: Laura Ragan, Legacy Region 3, 612-713-5157

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology and status of the Fassett's locoweed to inform this status review.

FR Notice citation announcing the species is under active review: November 5, 2021, FR 86, No. 221

Review History:

Two previous 5-year reviews have been completed for Fassett's locoweed; the first in 2009 and the second in 2013. The [2009 status review](#) provided new information regarding the species' status, distribution, and threats. The [2013 status review](#) provided updated population information from surveys conducted from 2009-2012. Both previous 5-year reviews recommended no change to the species' status as threatened.

In addition to two five-year status reviews, Fassett's locoweed was included in a cursory review conducted for all species listed before 1991 (56 FR 56882), which resulted in no change to the species' classification as threatened.

REVIEW ANALYSIS

Recovery Criteria

Recovery Plan or Outline: U.S. Fish and Wildlife Service. 1991. Fassett's Locoweed (*Oxytropis campestris* var. *chartacea*) Recovery Plan. Region 3, Twin Cities, Minnesota. 41 pp.
+Appendices.

The USFWS finalized the recovery plan for Fassett's locoweed on March 29, 1991 (USFWS, 1991). Delisting may be considered for Fassett's locoweed when all recovery criteria given in the recovery plan have been met. These criteria are:

1. "Protect the lake shorelines with Fassett's locoweed at all sites with naturally occurring populations. This includes the 6 extant populations (extant in 1991 when the Fassett's locoweed recovery plan was completed) as well as any new occurrences which might be found. Adequate protection will be accomplished not only through legal agreements with landowners but by increasing public awareness on the high-use lake shorelines. Where this is not possible, other methods should be pursued, including conservation easement and registry" (USFWS 2013).

This criterion has not been met, though many steps have been taken. Since the completion of the recovery plan, the Wisconsin Department of Natural Resources (WDNR) State Natural Areas (SNA) Program has acquired large portions of the population sites in central Wisconsin, including portions of Pickerel, Plainfield, Second, Sherman, and Weymouth Lakes. Mountain Lake is owned completely by the United States Forest Service (USFS). Pigeon Lake is owned partly by the USFS, The Board of Commissioners of Public Lands, and the University of Wisconsin system. However, portions of Fassett's locoweed sites are still privately owned, and Lake Huron is entirely private. Some landowners on Lake Huron have been actively protecting the Fassett's locoweed on their property, such as caging plants or prohibiting vehicle access to sites. Others have not taken any protective measures (USFWS 2013).

2. "Protected populations will be monitored and the site managed to maintain Fassett's locoweed. Management needs may include removal of nonnative plant species and other measures necessary to sustain shoreline habitat" (USFWS 2013).

This criterion has not been met, due to its ongoing nature. Population surveys are being conducted every year at Plainfield, Pickerel, and Second (apart from 2019-2020 due to high regional water levels; see information below under *Abundance, population trends, demographic features, or demographic trends*). Surveys at other Fassett's locoweed sites are conducted frequently (see information below under *Abundance, population trends, demographic features, or demographic trends*). Continued monitoring is still necessary to understand population dynamics and potential threats to the species.

3. “Removal of Fassett’s locoweed from the list of U.S. Endangered and Threatened Species will be considered when 6 populations are permanently protected and managed, and monitoring indicates the populations to be self-sustaining” (USFWS 2013).

This criterion has not been fully met. Frequent monitoring has been ongoing at many of the sites, including Plainfield, Pickerel, Second, Pigeon, and Mountain. However, it is unclear what constitutes a self-sustaining population of Fassett’s locoweed due to the species’ frequent population swings. Fassett’s locoweed is found along shorelines of seepage lakes fed by groundwater, which naturally have highly fluctuating water levels (USFWS 2013). All populations are currently submerged and have been since 2018 (see information below under *Abundance, population trends, demographic features, or demographic trends*). . Therefore, it is not known what will happen to the populations once the water level drops, though in previous submersion events the species has rebounded drastically once the shoreline becomes exposed again. However, we cannot conclude whether the populations are currently self-sustaining at this time.

Biology and Habitat

This section provides a brief overview of Fassett’s locoweed biological information. More extensive information can be found in the previous status reviews and the recovery plan.

Fassett’s locoweed is a threatened plant variety in the legume family and is endemic to only three counties in Wisconsin (Portage, Waushara, and Bayfield; Figure 1). Fassett’s locoweed primarily grows along sandy shorelines of shallow seepage lakes with highly fluctuating water levels. Water level is a major driver of population size, which can vary dramatically depending mainly on the annual precipitation and local water use. (USFWS 2013).

Fassett’s locoweed can rebound quickly from inundation events due to the presence of an extensive soil seed bank (i.e., natural storage of seeds in the soil, which serves as a repository for the production of subsequent generations of plants to enable their survival). Low germination rates over a long time serve as an advantage, preventing the entire seed bank being used during one period of favorable conditions. Favorable conditions may last for several years or may not last long enough for plants to produce more seeds. By not germinating all at once, the seed bank is able to sustain the entire population through several years of unfavorable conditions. Fassett’s locoweed is primarily a short-lived perennial, although it may have a longer lifespan in the areas above the high water line (USFWS 1991).

Updated Information and Current Species Status

Species biology and life history

Tippery (2015) found that seed germination in Fassett’s locoweed is highly dependent on physical damage to the seed coat, similar to many other plants in the Fabaceae (legume) family. In germination experiments, seeds with an intact seed coat had a very low rate of germination (about 7.8%) when compared to germination rates of seeds cut with a razorblade (61.1%) or seeds rubbed between sandpaper (71.1%). Seeds with thicker seed coats will persist longer in the

seed bank, and since Fassett's locoweed relies on an extensive seed bank to recover from population crashes, this adaptation likely heavily contributes to the persistence of the species (Tippery 2015). Seed germination is also predicted by the ability of seeds to absorb water. During a trial, locoweed seeds that did not increase in size after being soaked in water overnight, were determined to have insufficient damage to the seed coat. Seeds that did absorb water had a germination rate of almost 100% (Tippery 2016). Ultimately, findings from these studies found that for germination to be successful, there must be absorption of water, which is not possible without scarification (nicking, breaking, softening, or weakening of the outer shell to speed up seed germination)(Tippery 2015, Tippery 2016).

Tippery (2016) found that during the early stages of germination, Fassett's locoweed seedlings grow a root of 4 centimeters (cm)(1.6 inches (in)) or more in length. In germination experiments, seeds that were planted at the soil surface grew a hypocotyl (the part of the stem of an embryo plant beneath the stalks of the seed leaves and directly above the root) of 1 cm in length. In wild populations, there is no visible hypocotyl, and cotyledons (the embryonic leaf, first leaves to appear from a germinating seed) are usually visible just at the soil surface. This indicates that naturally seeds germinate at a depth of 1 cm (0.4 in) or more. In germination experiments, the effect of water depth on seedling establishment was tested using different length pipes to plant seeds. There were no observed differences in germination of seeds in 5 cm (2.0 in), 10 cm (3.9 in), or 15 cm (5.9 in) under water depth setups (Tippery 2016).

Abundance, population trends, demographic features, or demographic trends

Since the 2013 status review, population surveys at Plainfield, Pickereel, and Second Lake sites (in central Wisconsin, Figure 1) have been conducted every year from 2014 to 2018 (Tippery 2018; Appendix A, Table 1). No surveys were conducted in 2019 or 2020 due to high regional water levels, which have completely submerged all populations of Fassett's locoweed at those sites. Fassett's locoweed adults do not survive submersion events, although the seeds in the seed bank are able to germinate once water levels recede, exposing the substrate (K. Doyle, WDNR, personal communication, 2021). The species has survived high water level events in the past, due to the presence of an extensive seed bank (USFWS 2013).

Population surveys at Pigeon and Mountain Lake sites in northwestern Wisconsin (Figure 1) have been conducted intermittently from 2014- 2020 (Appendix A, Table 1). Small populations were found at Mountain Lake in 2014 and 2015 (22 and 20 individuals, respectively); however, no individuals were found at Mountain Lake from 2017-2020. Individuals were not found at Pigeon lake when surveys were conducted in 2014, 2019, and 2020. It is very likely that all individuals and all potentially suitable habitat at the two sites were underwater in 2019 and 2020 (K. Doyle, WDNR, personal communication, 2021).

Since the last status review (USFWS 2013), Plainfield Lake has had the highest population, with plants numbering in the thousands prior to 2018. There was a dramatic decline in the population at Plainfield Lake after 2016 when the water level rose precipitously. The population was approximately 120,871 plants in 2016 and decreased to 7,292 plants in 2017 and 479 plants in 2018 (Tippery 2014, Tippery 2015, Tippery 2016, Tippery 2017, Tippery 2018).

Since 2013 (though potentially historically as well), Plainfield and Pickerel Lake sites have both had certain portions of the lake shore that were more densely populated by Fassett's locoweed. Almost all Fassett's locoweed plants at Plainfield were observed along the northern and eastern shores. The population at Pickerel was not as densely populated, though the densest areas were observed at points on the northeast shore, western shore, and southern shore (Tippery 2014). Recently developed topographic and bathymetric maps of Plainfield, Pickerel, and Second Lakes have shown that the densest populations of Fassett's locoweed tend to occur along the areas of shoreline with gentle slopes, while the plants grow more sparsely along areas of steep slopes (Tippery 2018). These maps support information from the recovery plan, which states that Fassett's locoweed grows on gentle, sand gravel slopes along open shoreline, and to a lesser extent, higher ground under partial shade from adjacent vegetation (USFWS 1991).

Plainfield Lake has been the most frequently surveyed site since the mid-1980s, and detailed demographic studies have been conducted since 2006. A recent Wisconsin central sands lakes report combined studies conducted by WDNR, UW-Stevens Point, and UW-Whitewater with the observed lake level record, and a determination of the ideal water level for the continued persistence of Fassett's locoweed has been suggested (WDNR 2021). Populations were low or absent in 1986, 1994, 2002, and 2017-2019 when the lake levels were 1,098.6 – 1,103.4 ft above sea level (asl). These were years when the water level was high enough that the beaches flooded, and therefore suitable habitat was limited. In contrast, populations were high in 2005, 2012, 2014, and 2015 when lake levels were 1,095.2 – 1,098.0 ft asl. This suggests that at lake levels higher than 1,098.5 ft asl there is little to no available habitat for Fassett's locoweed (Voter et al. 2021). However, because locoweed requires periods of flooding, the report recognized that lake levels above 1,098.5ft asl will support the species as long as these periods are infrequent. The report also emphasized the importance of water level fluctuation to maintain long term viability of Fassett's locoweed and used a range of 1,095.1 to 1,100.5ft asl and median of 1,097.3ft asl as suitable based on historical lake levels at Plainfield Lake, recorded Fassett's locoweed numbers, and bathymetry data.

Spatial distribution, trends in spatial distribution, or historical range

At the time of the last status review, Fassett's locoweed occurred at ten sites throughout central and northern Wisconsin. Deer Print Lake was listed as a new site (discovered in 2008), and plants were found there for a few years, although no plants have been found at the site for more than ten years. However, it was later discovered that a member of the public planted that population, and the site is no longer considered a naturally occurring population (K. Doyle, WDNR, personal communication, 2021).

One plant was observed at Wolf Lake in 2005 (central Wisconsin, Figure 1); however, no plants have been seen since at this location despite multiple surveys. In 2019, multiple plugs grown from seed taken from Plainfield Lake were planted at the site by the Wisconsin DNR. However, the water level rose throughout the summer of 2019 and all plants were submerged. It is unknown if there is an available seed bank at the site (K. Doyle, WDNR, personal communication, 2021).

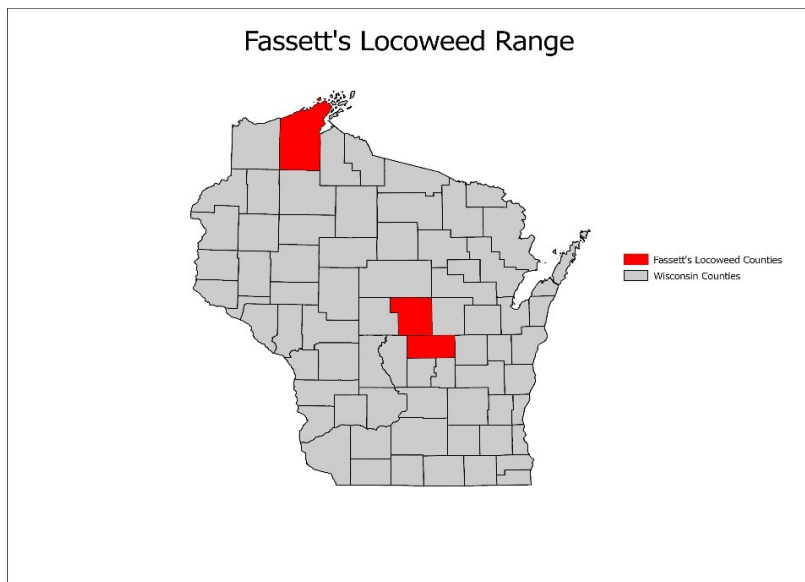


Figure 1. Current range of Fassett’s locoweed at the county level.

Threats Analysis (threats, conservation measures, and regulatory mechanisms):

Conservation Measures (since last 5-year review)

Since the last 5-year status review, frequent monitoring of populations (where possible) has continued. Surveys of Plainfield and Pickerel Lakes have been conducted every year from 2014 – 2018, and at Second Lake from 2015 – 2018 (see Appendix A, Table 1). Mountain and Pigeon Lakes haven’t been surveyed every year but have been surveyed since the previous five-year review. Mountain Lake was surveyed in 2014, 2015, 2017, and 2018. Pigeon Lake was surveyed in 2014. Weymouth Lake was surveyed in 2014-2015. Lake Huron was surveyed in 2014. Frequent population surveys provide the information needed to make determinations on whether a specific population is stable.

In 2016, two wells were established at Plainfield Lake with the goal of monitoring water levels. A well was intended to be dug at Pickerel Lake as well, but high water levels in 2016 would have made well digging extremely difficult (Tippery 2017). The wells at Plainfield Lake will ideally provide an easy way to monitor water levels along with increasing our understanding of how Fassett's locoweed responds to fluctuations in water level over time and informing any regional water use management.

Germination studies are ongoing, which have increased our understanding of how to grow Fassett's locoweed seedlings in artificial conditions. In 2019, Dr. Nicholas Tippery at the University of Wisconsin – Whitewater studied propagation techniques for Fassett's locoweed (Tippery 2019). Seeds were scarified and then soaked; conditions ranged from no soaking to overnight soaking. Seeds were then sown into soil at approximately 2 cm (0.8 in) depth and an inoculant was used. Once germinated, seedlings were watered from below once per week with tap or deionized water. After roughly one month in a growth chamber, seedlings were planted in vertical transects extending up the shore, away from the water's edge, in the first 2-3 meters (m) of exposed shoreline.

Throughout the summer of 2019, all the seedlings died as lake levels continued to rise and all the transects were submerged. However, the results of the propagation portion of this study documented important techniques for successful germination and establishment of Fassett's locoweed seedlings. Importantly, the greatest overall seed germination and seedling survival was found in two trays with rhizobium inoculant. This knowledge could aid in any augmentation or reintroduction efforts that may be conducted in the future. These studies have also provided an understanding of how important the seed bank is to the persistence of the species.

Threats

The listing rule for Fassett's locoweed (USFWS 1988), focuses on the limited distribution and small size of the populations. At the time of listing, known Fassett's locoweed sites occurred entirely on privately owned property. Human use and shoreline development of these areas was considered a major threat, as the species had been extirpated from historical sites in Bayfield and Waushara counties due to human development. Although not completely eliminated, the threat of human development has decreased; many Fassett's locoweed sites are no longer on private property. The other threat listed is livestock grazing, which had extirpated the species from one historical site. Grazing is no longer a threat to the species. The listing rule mentions the limited distribution and small population sizes multiple times, which are the main factors that led to the species' listing. Because Fassett's locoweed will likely always have a limited distribution, any factor which could eliminate a large portion of a population is considered a threat. Recent high regional water levels may be a new threat, as water levels at Plainfield Lake, Pigeon Lake, and presumably others increased to record highs in 2019 and all suitable Fassett's locoweed habitat has been submerged since. Even so, the duration of the flooding is likely more important than the degree, as long as there are roughly a few years of exposed habitat per decade, plants should be able to emerge, flower, and replenish the seed bank (K. Doyle, WDNR, personal communication, 2021). However, since recorded lake levels have never been this high, more research is needed to determine how current water levels will affect Fassett's locoweed long term.

Present or threatened destruction, modification or curtailment of its habitat or range

No new information since last status review. The Recovery Plan (USFWS 1991) lists development as a major threat to the species, but this threat has been greatly reduced (USFWS 2013).

Overutilization for commercial, recreational, scientific, or educational purposes

No new information since last status review.

Disease or predation

Field surveys at Plainfield, Pickerel, and Second Lakes reported high levels of herbivory in 2016 (Tippery 2016). The field survey estimated the percent of racemes (a flower cluster with separate flowers attached by short stalks) on a given reproductive plant that were lost to herbivory (complete removal of every flower and fruit per raceme), to be 57.1% at Pickerel Lake, 62.1% at Plainfield Lake, and 43.6% at Second Lake. Some potential sources of herbivory to the species are from deer and insects (USFWS 2013). It was noted that toward the end of the field season it was difficult to find any intact racemes that had not experienced some herbivory. It is not clear whether herbivory poses a major threat to other Fassett's locoweed populations, but it has the potential to decrease the amount of seeds in the seed bank, limiting locoweed's ability to recover from population crashes (Tippery 2016). After Pigeon Lake, Plainfield and Pickerel lakes support the next largest locoweed populations; therefore, loss of reproductive output for those populations would disproportionately threaten the species' viability rangewide.

Inadequacy of existing regulatory mechanisms

No new information since last status review.

Other natural or manmade factors affecting its continued existence

The Fassett's locoweed recovery plan (USFWS 1991) identified high capacity wells as a threat to the species. High capacity wells used for agriculture irrigation have been shown to affect groundwater levels, which can also affect lake level fluctuations. This has the potential to disrupt Fassett's locoweed populations, as the species depends on lake level fluctuations to outcompete competitor plant species. In 2021, The Wisconsin Department of Natural Resources (WDNR), in collaboration with the Wisconsin Geological and Natural History Survey, US Geological Survey, and the University of Wisconsin System, modelled and evaluated the impacts of groundwater withdrawals on lake levels at Plainfield Lake as part of the Central Sands Lakes Study (WDNR 2021). The project determined that current irrigated agriculture reduces the median lake level at Plainfield Lake and makes lake level fluctuations more extreme, threatening Fassett's locoweed viability. Further, the study found that 140 wells within 4 miles of Plainfield Lake would have to be removed to prevent significant reductions to lake levels (WDNR 2021). To reduce the impacts of high capacity wells, the DNR recommended the creation of a water use district for the Central

Sands region, which includes all Fassett's locoweed sites in Portage and Waushara counties, to manage groundwater withdrawal.

Annual precipitation in Waushara County (where Plainfield Lake is located) has increased since the 1950s, and water levels at Plainfield Lake and Pigeon Lake (in distant Bayfield County) rose to record highs in 2019 (US Climate Divisional Database, NOAA, 2020). Levels at other lakes are also above all suitable Fassett's locoweed habitat (K. Doyle, WDNR, personal communication, 2021). Since 1980, water levels at Plainfield Lake have tended to transition from high to low every 7 years on average, although lake water levels tended to be above average for longer durations than below average (WDNR 2021). The interaction between groundwater withdrawals and increased annual precipitation, along with periodic droughts may result in more extreme fluctuations to lakes supporting Fassett's locoweed. It is unknown how the species will respond to continued fluctuations and thus, flooding (along with groundwater withdrawal) is considered a potential threat. Due to the uncertainty surrounding the long-term effects of sustained high water levels on Fassett's locoweed, it will be important to commence monitoring populations again immediately once the water levels eventually recede.

Populations of invasive species were dense at some sites before water levels increased. Invasive species can threaten Fassett's locoweed by overcrowding and outcompeting them (USFWS 2013). However, it is believed that many of the encroaching species will have large population declines due to the current high water levels (N. Tippery, UWW, personal communication, 2021). If this is the case, then it may be several years before invasive species again become a threat to Fassett's locoweed populations.

Synthesis

Fassett's locoweed is a rare endemic species with a very limited distribution. Found in only a maximum of 9 sites (7 in central Wisconsin and 2 in northwest Wisconsin), any factor that impacts its habitat adversely could have major consequences. Although the threats listed in the Recovery Plan (USFWS 1991) such as development and recreational activities have not been eliminated, they have been reduced at several sites. At the time of listing, none of the sites at which Fassett's locoweed occurred were fully protected. Now, seven sites have partial or full protection, and populations that occur on private property have received decent protection from most landowners. Although portions of most sites are in state or federal protection, efforts should still be made to educate private landowners that have Fassett's locoweed on their property, and if possible, acquire more land that contains populations.

High capacity wells are still an increasing threat. Although water levels are currently high, current irrigated agriculture is significantly impacting locoweed habitat at Plainfield Lake by lowering the median lake level and creating more extreme fluctuations (WDNR 2021). The same impacts are likely occurring at other lakes nearby where Fassett's locoweed is found. The groundwater withdrawal from these wells could lead to much lower water levels over the long term, which would only exacerbate the effects during periods of drought. The number of high capacity pumping wells has increased in central Wisconsin over time and has lowered the groundwater levels by more than one meter (Kraft et al. 2010). Two wells were established at Plainfield Lake in 2016 in order to monitor water levels and this monitoring should continue.

This monitoring will lead to an increased understanding of how the hydrologic regime impacts the species, which can be applied to the regional water use management (Tippery 2017).

Herbivory, presumably by deer, may pose a significant threat at some sites, although confirmation will require additional monitoring. Invasive species may also pose a threat to Fassett's locoweed by competing and overcrowding, especially at sites with increased invasive species density. This threat is only present when water levels are low. If water level fluctuations occur frequently, then invasive species may not be a threat if they cannot establish themselves within a short time frame. However, with the potential impacts of climate change, droughts may become more common, which would give invasive species time to establish and outcompete Fassett's locoweed.

Prior to the water level rise, Plainfield Lake had the largest population (approximately 120,871 plants in 2016). Pickerel and Weymouth Lakes also had populations numbering in the thousands in 2015 (see Appendix A, Table 1). Once water levels recede, regular population monitoring should resume annually at these sites to assess the status of the populations, especially due to the uncertainty surrounding the effects that sustained high water levels will have on the species.

At this time, a change in status is not warranted for Fassett's locoweed. Although threats have not been eliminated, they have been reduced across most sites due to land acquisition and increased landowner education. Based on the current threat levels and the rarity of the species, Fassett's locoweed may become endangered in the foreseeable future, and thus meets the definition of a threatened species. All populations likely have declined significantly since 2017 due to a rise in water levels across current sites, and no plants have emerged aboveground since 2018. However, large fluctuations in population numbers have been seen multiple times in the past, and these fluctuations correspond to the change in water levels. Due to all populations likely being submerged, it is not clear how site numbers will respond when and if water levels drop again. From previous population cycles, we expect that numbers at all sites should increase once shoreline habitat is available. If water levels drop and the populations do not rebound, then it would be appropriate to consider a change in status. However, with current available information, Fassett's locoweed should remain listed as threatened.

Recommended Recovery Actions

1. Continue to strive to achieve the highest possible level of land protection at all extant sites.
2. Continued annual monitoring of Fassett's locoweed populations and water levels.
 - a. Studies should be conducted at Plainfield, Pickerel, and Second Lakes once water levels recede to better understand the seedling establishment phase. Data should be gathered on spatial patterns of germination, survival, growth, and competition.
 - b. Annual water level monitoring should continue to better understand the relationship between lake water levels and Fassett's locoweed population fluctuations, which will inform regional water use management.
3. Continued communication and education of private landowners.
 - a. Landowner participation in protection actions pertaining to the Fassett's locoweed on their property should be sought. The goal should be to get as many landowners

- to participate as possible.
4. Continued herbivory monitoring.
 - a. If herbivory is found to be a significant threat, certain populations should be fenced.
 5. Continued invasive species monitoring.
 - a. Once water levels recede and Fassett's locoweed populations reestablish, studies should be conducted to determine the threat levels posed by various invasive species. If deemed a threat, invasive species should be removed from sites in close proximity to Fassett's locoweed populations.
 6. Evaluate if population augmentation at sites with small populations is necessary and advisable.
 - a. Due to high water levels it will be necessary to wait until water levels recede to assess if augmentation is a need.
 7. Search for new sites and/or potential reintroductions to historical sites.
 - a. Searches for new sites should continue. Although all extant sites may have already been found, seeds have the ability to persist in the seed bank for many years, and sites that are currently flooded may have an unknown population of Fassett's locoweed.
 - b. Reintroduce Fassett's locoweed to historical sites where appropriate based on habitat suitability, protection level, and absence of threats like recreation and invasive species infestation.
 8. Seed storage.
 - a. Once populations have the chance to reestablish, more Fassett's locoweed seeds should be collected for storage at approved seed storage facilities. Having a collection of stored seeds could help protect the species if a population crash were to occur (such as by the effects of climate change) and provide material for reintroduction efforts.
 9. Conduct seed bank studies.
 - a. The seed bank serves a very important function in maintaining populations of Fassett's locoweed after a population crash due to fluctuating water levels. Having more knowledge of the seed bank, how it functions, and the limit of its ability to restore populations could help improve protective management.
 10. Conduct pollinator studies. Studies should be conducted on the pollinators of Fassett's locoweed to better understand the specific pollinator species that are important during various times throughout the blooming period. Various locations should also be studied to see if pollinator species vary by site.
 11. Determine how a self-sustaining population should be defined for the species, especially considering that populations may not emerge for many years due to water level changes.
 12. Continue to conduct propagation experiments.
 - a. Although improvements have been made in seed germination, we have not successfully grown mature, reproducing plants. This will be critical for any ex situ efforts.

RESULTS

**U.S. FISH AND WILDLIFE SERVICE
STATUS REVIEW of *Oxytropis campestris* var. *chartacea***

Current Classification: Threatened

Status Recommendation resulting from Status Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist (Indicate reasons for delisting per 50 CFR 424.11):
 - The species is extinct
 - The species does not meet the definition of an endangered or threatened species
 - The listed entity does not meet the statutory definition of a species
- No change needed

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date _____

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Wisconsin Department of Natural Resources (WDNR). 2021. APPENDIX B: Central Sands Lakes Study Technical Report: Lake Ecosystem Characterization and Response. 257pp.

Appendix A:

Table 1. Population Estimates of Fassett's Locoweed Sites (2013-2020)

Site	Pickrel Lake	Plainfield Lake	Second Lake	Sherman (Marks) Lake	Weymouth Lake	Lake Huron	Pigeon Lake	Mountain Lake
County	Portage	Waushara	Waushara	Waushara	Waushara	Waushara	Bayfield	Bayfield
2013	191 plants	No data	No data	No data	No data	No data	No data	No data
2014	337 plants; 32 seedlings (9.5%), 218 non-reproductive (64.7%), 87 reproductive (25.8%)	136,473 plants; 12,861 seedlings (9.4%), 102,618 non-reproductive (75.2%), 20,994 reproductive (15.4%)	No data	No data	100+ plants (survey incomplete)	29 plants; 1 seedling, 3 non-reproductive, 25 reproductive	0 plants found	22 plants
2015	4,326 plants	188,225 plants	91 plants	No data	3,345 plants	No data	No data	20 plants
2016	285 plants; 7 seedlings (2.5%), 226 non-reproductive (79.3%), 52 reproductive (18.2%)	120,871 plants; 7,680 seedlings (6.4%), 56,497 non-reproductive (46.7%), 56,694 reproductive (46.9%)	196 plants; 0 seedlings, 65 non-reproductive (33.2%), 131 reproductive (66.8%)	No data	No data	No data	No data	No data
2017	0 plants found	7,292 plants; 2,280 seedlings (31.3%), 2,807 non-reproductive (38.5%), 2,205 reproductive (30.2%)	0 plants found	No data	No data	No data	No data	0 plants found
2018	11 plants; 1 seedling (9.1%), 7 non-reproductive (63.3%), 3 reproductive (27.3%)	479 plants; 20 seedlings (4.2%), 341 non-reproductive (71.2%), 118 reproductive (24.6%)	0 plants found	No data	No data	No data	No data	0 plants found
2019	No data	No data	No data	No data	No data	No data	0 plants found	No data
2020	No data	0 plants found (underwater)	No data	No data	No data	No data	0 plants found	No data
2021	No data	0 plants found (underwater)	No data	No data	No data	No data	No data	No data