

Fassett's Locoweed
(Oxytropis campestris var. chartacea)

**5-Year Review:
Summary and Evaluation**



**U.S. Fish and Wildlife Service
Wisconsin Ecological Services Field Office
New Franken, Wisconsin**

2013

5-YEAR REVIEW

Species reviewed: Fassett's locoweed (*Oxytropis campestris* var. *chartacea*)

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Photo on cover page courtesy of Joel Trick, USFWS (Retired)

5-YEAR REVIEW
Fassett's Locoweed/*Oxytropis campestris* var. *chartacea*

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office: Midwest Region

Contact: Jessica Hogrefe, Endangered Species Division, 612-713-5339.

Lead Field Office: Wisconsin Ecological Services (ES) Field Office

Contact: Cathy Carnes, Endangered Species Coordinator, 920-866-1732.

Cooperating Field Office(s): NA

Cooperating Regional Office(s): NA

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (USFWS) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (16 U.S.C. 1531 *et seq.*). The USFWS provided notice of this status review via the Federal Register (76 FR 143) on July 26, 2011, requesting new information on Fassett's locoweed (*Oxytropis campestris* var. *chartacea*) that may have a bearing on its classification as threatened. Dr. Tracy Feldman, University of Wisconsin–Stevens Point (UW-SP), was contracted to update sections 2.2 and 2.3 of the 2009 5-Year Review for Fassett's Locoweed (USFWS 2009), which was heavily relied upon to complete this 5-year review. New information and population data from 2009 to present was incorporated into the 5-year review. Staff from the Wisconsin Department of Natural Resources (WDNR) including Thomas Meyer, Kevin Doyle, and Darcy Kind and Matt Bushman from the U.S. Forest Service provided helpful comments on preliminary drafts of the 5-year review. Cathy Carnes, Endangered Species Coordinator, USFWS, Wisconsin ES Field Office completed the draft with the assistance of Dr. Tracy Feldman. A final draft was reviewed by Matt Bushman (USFS) and Kevin Doyle (WDNR) who provided additional helpful comments that have been incorporated into the 5-Year Review. The final review and recommendations were prepared by Cathy Carnes of the USFWS Wisconsin ES Field Office.

The USFWS did not carry out a formal peer review of this 5-year review. The 2009 5-year review for this species underwent peer review for scientific accuracy. The new information since 2009 contained in this review does not have significant scientific uncertainty or has undergone individual peer review (e.g.,

peer reviewed publications). Further, we do not anticipate controversy with any of the information or conclusions within this document.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review: 76 FR 143, Tuesday, July 26, 2011.

1.3.2 Listing history

Original Listing

FR notice: 53 FR 37970-37972

Date listed: Wednesday, September 28, 1988

Entity listed: Subspecies

Classification: Threatened

1.3.3 Associated rulemakings: None

1.3.4 Review History:

In 2009 the USFWS completed a 5-year status review for Fassett's locoweed. The USFWS provided notice of this status review via the Federal Register (72 FR 141) on July 26, 2011. The 5-year review resulted in no change to the listing classification of threatened. There have been no biological opinions or other large scale analysis of this species.

Fassett's locoweed was included in a cursory 5-year review conducted for all species listed before 1991 (56 FR 56882). The 5-year review resulted in no change to the listing classification of threatened.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 9 (indicating a subspecies with a moderate degree of threat and high potential for recovery).

1.3.6 Recovery Plan

Name of plan: Fassett's Locoweed (*Oxytropis campestris* var. *chartacea*) Recovery Plan

Date issued: March 29, 1991

Dates of previous revisions, if applicable: NA

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *No*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? *Yes*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? *Yes*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? *Yes*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The recovery objective of the Fassett's locoweed recovery plan is to protect and maintain existing populations for the foreseeable future (Executive Summary). The recovery criteria presented below are gleaned from the Executive Summary and Part II, RECOVERY, OBJECTIVE of the recovery plan (USFWS 1991).

Delisting criteria:

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.

This criterion has not been met. Efforts to meet this criterion are ongoing. Currently there are 10 lakes with extant Fassett's locoweed populations. These include the 6 lakes extant in 1991 when the recovery plan was completed [Pickerel, Plainfield, Second, Sherman (Marks), and Weymouth lakes, and Lake Huron], the 3 new lakes found since completion of the recovery plan (Wolf, Mountain and Deer Print lakes) and Pigeon Lake identified as historic when the recovery plan was completed in 1991, but which currently supports an extant population of Fassett's locoweed (refer to Appendix B).

Seven of the 10 extant sites are in partial or entire public ownership. Those are Second, Sherman, Weymouth, Plainfield and Pickerel lakes, owned in part by the Wisconsin Department of Natural Resources (WDNR) State Natural Areas (SNA) Program, Mountain Lake owned entirely by the United States Forest Service (USFS), Chequamegon-Nicolet National Forest, and Pigeon Lake owned in part by the USFS and the University of Wisconsin system. Wolf Lake is partially owned by Portage County. Deer Print Lake is owned by a private company, Lyme St. Croix Forest Company LLC (Matt Bushman, USFS pers. comm. 2012). The remaining site (Lake Huron) is owned by multiple private parties (refer to Appendix B).

There are currently no conservation easements or other legal instruments (e.g., fee title purchases) in place on the two privately held sites (Lake Huron and Deer Print Lake) nor on Wolf Lake. In addition no private landowners have registered their lands with WDNR. Registry of a site is not a legally binding agreement (Darcy Kind, *in litt.* 2008); it is an informal agreement with a private landowner for the protection of a rare species. While not legally binding, registry of lands can be a valuable tool, creating allies in the work of rare species protection (David Kopitzke, *in litt.* 2008). The WDNR Bureau of Endangered Resources had an active land owner contact program until about 2006, and they continue to communicate with landowners as staffing allows to pursue the strongest conservation measure possible at the Fassett's locoweed sites.

The WDNR SNA Program continues to protect additional acreage of Fassett's locoweed through fee acquisition. At the Plainfield Tunnel Channel Lakes SNA, a 119-acre tract protecting the south and east shoreline of Plainfield Lake was acquired in 2008. In 2010, the WDNR acquired a 99-acre tract along the west shore of Weymouth Lake (Thomas Meyer, WDNR, 2012).

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.

This criterion has not been met. The monitoring and management criteria are ongoing and continue to be necessary to maintain viable populations. Semi-regular monitoring has occurred on accessible portions of all sites since the recovery plan was completed in 1991 (refer to section. 2.3.1.2 "Abundance, trends, and demographic features"). Continued monitoring is necessary to understand the population dynamics of the species, and the effects of threats like prolonged low water levels, invasive plants, and human disturbances on those dynamics. Continued management is necessary to identify and minimize threats to the species.

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.

These criteria have not been wholly met. Currently 7 of the 10 extant populations are, in part or wholly permanently protected on publicly-owned land (Second, Sherman, Mountain, Plainfield, Pigeon, Weymouth and Pickerel lakes) (refer to Appendix B). Only one of these sites, Mountain Lake, has shoreline that is entirely protected by State or Federal agencies (Thomas Meyer, WDNR, pers. comm. 2012). The SNA Program continues to work toward expanding acquisition at the Plainfield Tunnel Channel Lakes SNA, which includes the shorelines of Plainfield, Second, Sherman, and Weymouth Lakes. The program is also pursuing expansion of the Pickerel Lake SNA. Additional permanent protection options are being pursued at other sites.

Monitoring data demonstrate that populations fluctuate greatly in size depending upon available suitable habitat and germinant survival, indicating that although a few populations have achieved high numbers (e.g., Plainfield, Pickerel, and Pigeon lakes), it is unclear if these populations are self-sustaining. Plainfield Lake is probably the lake that is closest to a large, self-sustaining population. Some moderate (Mountain Lake) or smaller (e.g., Weymouth Lake) populations may be self-sustaining, even though they support fewer plants. Very small populations (30 plants or less) are present at Lake Huron, Deer Print Lake and Wolf Lake (Appendix A, Table A2). The fact that there are so few populations, and most populations are very small, supports the need for continued protection of the species.

Criteria as they relate to the 5-listing factors:

The delisting criteria identify the need to:

1. Protect populations and shoreline habitat at essentially all known Fassett's locoweed sites through fee simple purchase or other methods,
2. monitor and manage populations and take measures necessary to sustain shoreline habitat, and
3. establish 6 self-sustaining populations that are permanently protected.

The above three criteria directly and/or indirectly address the following 5-listing factors:

- *Present or threatened destruction, modification or curtailment of its habitat or range:* all 3 recovery criteria address this listing factor.
- *Overutilization for commercial, recreational, scientific, or educational purposes:* no criteria needed, not a threat.
- *Disease or predation:* addressed by second recovery criterion.
- *Inadequacy of existing regulatory mechanisms:* addressed by recovery criteria 1 and 2 (refer to section 2.3.2.5 below).

- *Other natural or manmade factors affecting its continued existence:* addressed by second recovery criterion.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

In a pilot study on the population genetics and phylogeography of Fassett's locoweed, Chung et al. (2004) found that self-fertilization and apomixis (asexual reproduction) were absent or rare (<2% of flowers within bagged inflorescences set fruit). Therefore propagation of Fassett's locoweed occurs sexually through production and dispersal of seeds.

Healthy pollinator populations are important for this species. Visitors to Fassett's locoweed flowers include *Bombus* spp. (possibly *B. fervidus* and *B. rufocinctus*), smaller native bees, *Apis mellifera*, bombyliid flies, as well as day-flying Lepidoptera including sphingids (*Hemaris diffinis*), skippers (*Poanes hobomok*), and butterflies (*Vanessa* sp.) (Tracy Feldman, pers. obs. at Plainfield and Pickerel lakes, 2009-2012). Karner blue butterflies (*Lycaeides melissa samuelis*), federally-listed as endangered, were occasionally observed visiting flowers at Pickerel lake (Tracy Feldman, pers. obs., 2010) (refer to photo below). At Plainfield and Pickerel lakes, several plant species co-flower with Fassett's locoweed, which could serve to attract pollinators, but few of these species produce abundant flowers during the main flowering period of Fassett's locoweed except non-native yellow hawkweed species (*Crepis* and *Hieracium* spp.) (Tracy Feldman, pers. obs., 2009-2010).

Fassett's locoweed blooms primarily at the end of May through mid-June, although occasional plants bloom as late as November (Tracy Feldman, pers. obs., 2009-2012). Based on preliminary information from a matrix model, the mean lifespan of Fassett's locoweed appears to vary from 1-4 years depending upon the life stage, the lake from which data were used, and the year data were collected. The variation around those means is from less than one to slightly greater than 10 years. Thus, life span estimates range from less than one year to potentially over 14 years (Tracy Feldman, pers. comm., 2013).

Seed production was found to be variable. Racemes (fruit stalks) per plant varies from zero to 116 (possibly more), fruits per raceme vary from zero to 32 (possibly more), and seed production per fruit from zero to more than 13 seeds. Given this, seed production per plant has the potential to vary from zero (even in a "reproductive" plant) to well over 10,000 seeds per plant. Larger plants produce more racemes and more fruits per raceme. Thus, numbers range from fairly low numbers of seeds per plant

in small plants to several hundred (or even in the 1000s) for larger plants, on average (Tracy Feldman, pers. comm., 2012) (Feldman 2012).

Most seeds, based on soil core samples taken from Plainfield and Pickerel lakes, are found to be in the top 5 cm (about 2 inches) of the soil. More seeds were found in 2008 than in other years (none were found on Pickerel Lake in 2009). Data suggest that the seed banks on these lakes are patchy but could be very large (Feldman 2010).

While seed banks may be large, seed germination rates vary, and field germination rates may be low. Feldman (2010) tested 109 seeds from 28 plants and found that 50-70% were viable. In a subsequent germination test by Feldman (2011), 95% (93 seeds) of 98 seeds collected from mock seed banks in the field were viable after seed coats were cut. However, only 0-1% of intact seeds germinated in greenhouse and field germination experiments. Seeds appear to germinate in bands along the shoreline at some range of distances above the water line. However the cues that result in increased germination, the ages of seeds at the time germination and factors that promote seedling establishment all remain largely unknown (Feldman 2012).

Seedling mortality was found to be high as well. The majority of Fassett's locoweed seedlings were found to die within two growing seasons. The probability that a plant survives to the next year ranges from less than 20% for smaller plants to over 50% for larger plants (Feldman 2012).

Experiments by Feldman (2012) to assess factors affecting seedling establishment indicate that presence of organic matter, including living organisms such as mosses, lichens, and small vascular plants, likely increases the probability of seedling establishment. Organic matter holds together loose sand and collects moisture, perhaps creating a microclimate suitable for seedling establishment. Feldman's (2012) research showed a trend toward increased seedling establishment in patches of mosses.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Most of the Fassett's locoweed populations in central and northwestern Wisconsin have been qualitatively monitored and surveyed on a semi-regular basis since the 1990s (Appendix A, Table A1, USFWS 2009). The Fassett's locoweed populations at Mountain and Pigeon lakes in northwestern Wisconsin have been surveyed by the USFS. Plainfield and Pickerel lakes support the two largest populations of Fassett's locoweed in central Wisconsin. Populations at these two lakes have been closely monitored for many years by the WDNR (Dobberpul, unpublished data) (WDNR, Thomas Meyer, pers. comm., 2012). A quantitative monitoring

protocol was developed and implemented at Plainfield and Pickerel lakes beginning in 2006 by Almasi (2006, 2007), and WDNR botanists continued implementation of that monitoring plan in 2008 (Craig Anderson, WDNR, pers. comm., 2008). From 2009-2012 monitoring has been conducted at both lakes by Feldman (2009, 2010, 2011, 2012), who further modified the monitoring program.

Populations of Fassett's locoweed have fluctuated considerably from 1989 to 2012 (Figures 1, 2, and 3, and Appendix A, Tables A1 and A2). In 1989, populations at several of the lakes (Plainfield, Second, Weymouth, Mountain lakes and Lake Huron) were moderate to high. In the early 1990s, populations plummeted due to high water levels and reduced shoreline habitat. Since the late 1990s, populations have increased significantly and have generally remained stable due to low water levels in the lakes and expanded habitat. As of 2008, several of the populations exceeded or regained their high numbers of 1989 (Figures 1, 2 and 3). More detailed information is summarized below for each lake.

Of the 10 lakes that support Fassett's locoweed, the plant currently occurs in highest numbers (thousands) at 4 lakes; Pigeon, Mountain, Plainfield, and Pickerel lakes. The Pigeon Lake population experienced a dramatic rise from 1-2 plants observed prior to 2009 to thousands of plants during 2009-2012 due to lower water levels exposing considerably more suitable shoreline habitat. In 2007, about 1000 Fassett's locoweed plants were present at Mountain Lake. Those plants and seedlings were found in the upper, or older, beach zones with none found in the most recently exposed sands closer to the water (Spuhler 2007). From 2009 to 2012, the population at Mountain Lake has been stable with about 5000 plants present each year (Appendix A, Tables A1 and A2).

The Plainfield Lake population has been high (at or > 60,000 plants) since 2004; high numbers (> 14,000 plants) have been observed at Pickerel Lake since 2006. The high population numbers recorded from these two lakes are due to a substantial increase (by thousands) in the number of seedlings. However, the numbers of non-seedling plants have decreased at these lakes during this same time period (Feldman 2011, 2012) (Appendix A, Tables A1 and A2). Fassett's locoweed locations have been mapped at Plainfield and Pickerel lakes (Almasi 2007; Feldman 2009, 2010, 2011, 2012).

Feldman's demographic work with Fassett's locoweed plants at Plainfield and Pickerel lakes suggest that increasing plant size (measured as diameter across the largest plant axis) positively affects survival and reproduction and negatively effects growth (change in plant diameter from one year to the next) (Feldman 2010, 2011, 2012). Thus, plant size is likely a more informative way to characterize Fassett's locoweed plants. Although locoweed plant density can be very high (>100 plants or >400 seedlings

Figure 1. Estimates of Fassett's locoweed populations for Pickerel and Plainfield lakes from 1988 to 2012.

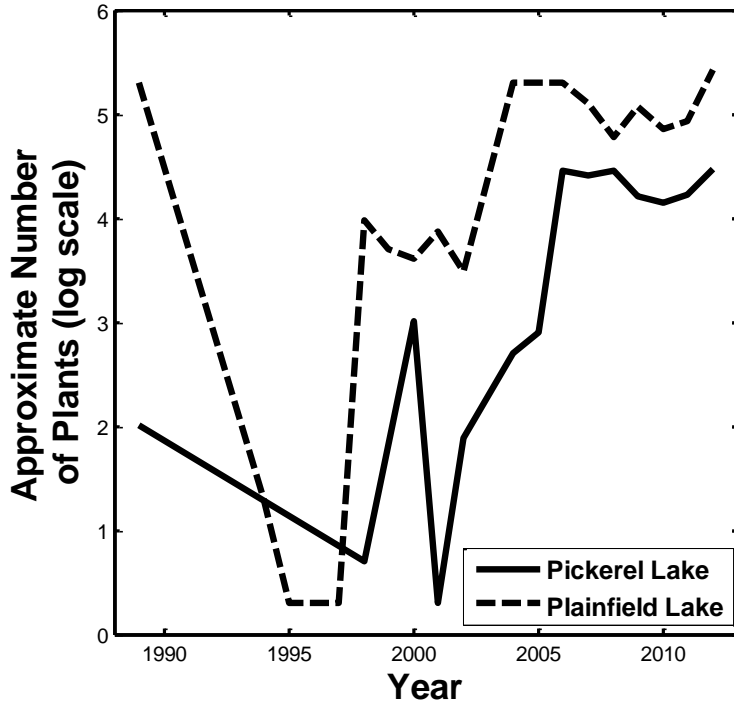


Figure 2. Estimates of Fassett's locoweed populations for Second, Sherman, and Weymouth lakes, and lake Huron from 1988 to 2012.

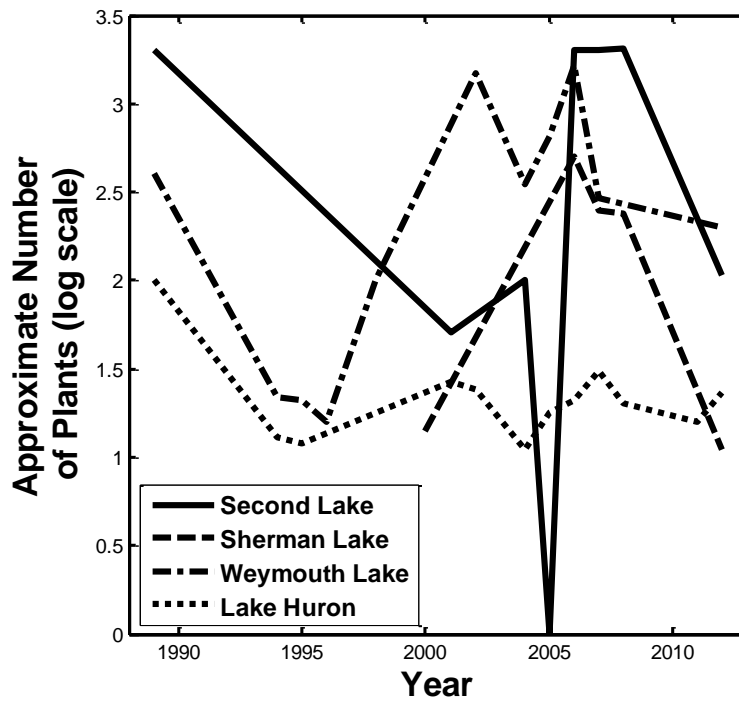
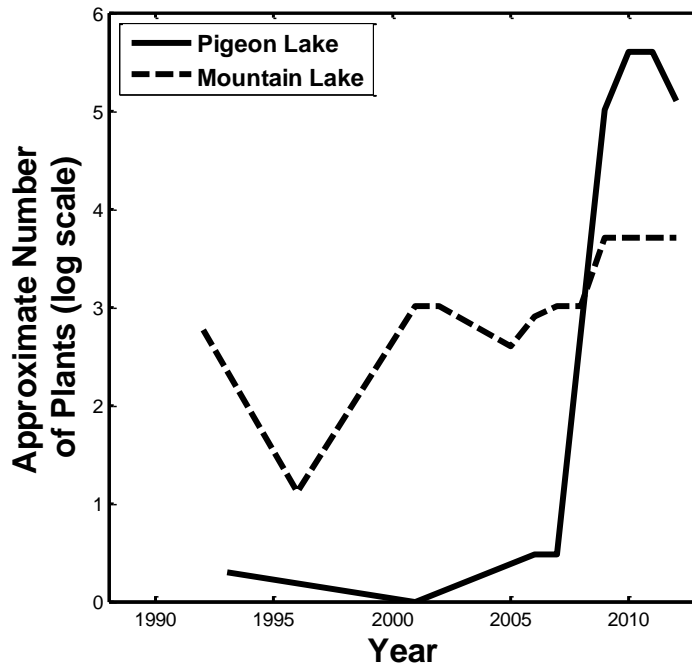


Figure 3. Estimates of Fassett’s locoweed populations for Pigeon and Mountain lakes from 1988 to 2012.



Notes pertaining to Figures 1-3: Population estimates begin in 1988, the year Fassett’s locoweed was federally-listed as threatened. Not all sites have available data for every year. All population estimates are approximate and are shown on a log scale (in which $\log(1) = 0$, $\log(10) = 1$, $\log(100) = 2$, $\log(1000) = 3$, etc.). For populations expressed in ranges (Appendix A, Table A1), the midpoint of the range was used (Appendix A, Table A2). Estimates for populations at Plainfield and Pickerel lakes were more accurate after 2005 because more detailed surveys were done (Almasi 2006, 2007; Feldman 2009, 2010, 2011, 2012). Also, population increases at these two lakes since 2010 reflect increases in seedlings and small plants (Feldman 2012). More detailed population information can be found in Appendix A (Table 1) below and Appendix A of the 2009 Fassett’s Locoweed 5-Year Review (USFWS 2009).

per square meter) and very low at a given site, the density of neighboring Fassett's locoweed plants had little to no effect on growth, survival, or reproduction. This likely indicates that differences in habitat quality in different locations on a given lake affect plant fitness.

In 2009-2012, numbers of seedlings and small plants increased substantially at both Plainfield and Pickerel lakes while numbers of larger plants decreased. Thus, while populations at these lakes appear to be increasing (Figure 1), the majority of seedlings and small plants (which make up the majority of the population at these sites) may be unlikely to survive the year. Feldman (2012) found that larger plants survive at a higher rate than smaller ones. Projection matrix models indicate that populations at each lake may be increasing or decreasing in the short term, but are predicted to decrease in the long term. Population viability analyses incorporating temporal variation will likely yield better predictions of long-term population dynamics on these lakes.

In order to estimate the impact of seed survival rates on populations, Feldman (pers. comm., 2013) used hypothetical seed survival rates of 90-100% in his projection matrix model (as he did not have actual field estimates of seed survival rates). The model results indicated that the population growth rate was most affected by changes in seed survival and seed production, highlighting the importance of future studies on seed bank dynamics in this species.

Up to 2000 plants were observed at Second Lake from 2006-2008 however the current population level is unknown. Lesser numbers of plants occur at Weymouth and Sherman lakes (populations generally number in the hundreds). Very small populations (30 plants or less) have been recorded from Lake Huron, Deer Print Lake and Wolf Lake (Appendix A, Table A2). Only one plant was observed at Wolf Lake in 2005; no plants have been seen there since.

Note: Appendix C provides a survey protocol for Fassett's locoweed which divides the plants into three categories; reproductive, non-reproductive, and seedlings. The protocol is based on work done by Almasi (2006, 2007) at Plainfield and Pickerel lakes and used by Feldman (2009-2012). It is recommended that this protocol be used by subsequent surveyors and researchers as it will provide consistency in data collection and analysis.

Monitoring potential habitat

Fassett's locoweed potential habitat has also been monitored in central and northwestern Wisconsin. Despite these searches, the Mountain, Wolf, and Deer Print Lake populations documented in 1992, 2005, and 2008,

respectively, are the only additional Fassett's locoweed sites found since completion of the recovery plan (USFWS 1991). The Deer Print Lake site differs from the two other known locations for this species in northwestern Wisconsin (Pigeon and Mountain lakes) in that the soil is much sandier, droughty, and lacking organic materials, and there are no other legume species on site (Bushman 2011). Further information on searches conducted for this species is summarized below:

- In 2010, O'Connor (2010) surveyed 7 lakes in central Wisconsin with historical populations or potential habitat for Fassett's locoweed and found no plants on those lakes. In the past, surveys in central Wisconsin were part of a now discontinued landowner contact program conducted by the WDNR.
- Fassett's locoweed surveys were conducted by Spuhler (2006) at about 39 sites in Bayfield County and by Spickerman (2007) at 19 sites in northwestern Wisconsin. Even though several of these lakes have suitable habitat, no Fassett's locoweed were found.
- In 2010 Dan Spuhler (WDNR contractor) identified 70 sites with potential habitat in Douglas County and surveyed 54 of those sites, finding the plant at only one known site, Deer Print Lake (Bushman 2011).
- Of 26 sites surveyed over a 21 year period (1990-2011) in Bayfield County, Fassett's locoweed has only been recorded at the 2 known sites, Mountain and Pigeon lakes. An additional 45 sites have been identified as having potential Fassett's locoweed habitat in Bayfield County but as yet have not been surveyed (Bushman 2011).
- Spickerman (2007) has recommended that potential habitat in western Douglas County be surveyed.

2.3.1.3 Genetics, genetic variation or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

The Fassett's locoweed populations in northwest and central Wisconsin are separated by over 240 km (149 miles). In central Wisconsin, populations in Waushara County are separated from the Portage County population by about 24 km (15 miles) (USFWS 1991).

Chung et al. (2004) analyzed patterns of genetic variation within and among six populations (Second Lake, Lake Huron, Weymouth Lake, Plainfield Lake, Pickerel Lake, and Mountain Lake) of Fassett's locoweed and their relationship to other members of the *O. campestris* complex across northern North America. Fassett's locoweed within-population

measures of genetic diversity were high compared with other herbaceous plants. Estimates of among-population differentiation were low, consistent with out-crossing. Morphologically speaking, the northwest and central Wisconsin populations are similar, indicating a lack of genetic drift or differentiation (Chung et al. 2004). Considering the high level of genetic diversity within populations, maintaining the ecological conditions that favor the life cycle of this plant may be a more pressing concern than the erosion of genetic variation (Chung et al. 2004).

Fassett's locoweed undergoes frequent population fluctuations, therefore it appears genetic diversity is preserved by the seed bank (Chung 2001). High within-population diversity and relatively low among-population differentiation are consistent with populations of Fassett's locoweed being relicts of a more continuous Pleistocene distribution (Chung et al. 2004).



The Fassett's locoweed population at Pigeon Lake in northern Wisconsin experienced a dramatic rise from 1-2 plants observed prior to 2009, to thousands of plants from 2009-2012. Photo courtesy of Emmet Judziewicz, UW-SP, 2009.

Female Karner blue butterfly on Fassett's locoweed plant at Pickerel Lake in central Wisconsin, 2012. Photo courtesy of Tracy Feldman, UW-SP.



2.3.1.4 Taxonomic classification or changes in nomenclature:

Chung et al. (2004) also examined the phylogeny of Fassett's locoweed (*Oxytropis campestris* var. *chartacea*) with respect to the *O. campestris* complex. Results support a sister relationship between var. *chartacea* and var. *johannensis*, which was proposed by Barneby (1952) based on morphological and biogeographical grounds. Chung's et al. (2004) analysis, however, indicates that each variety is a distinct lineage. The genetic research supports recognition of Fassett's locoweed as a distinct taxon.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

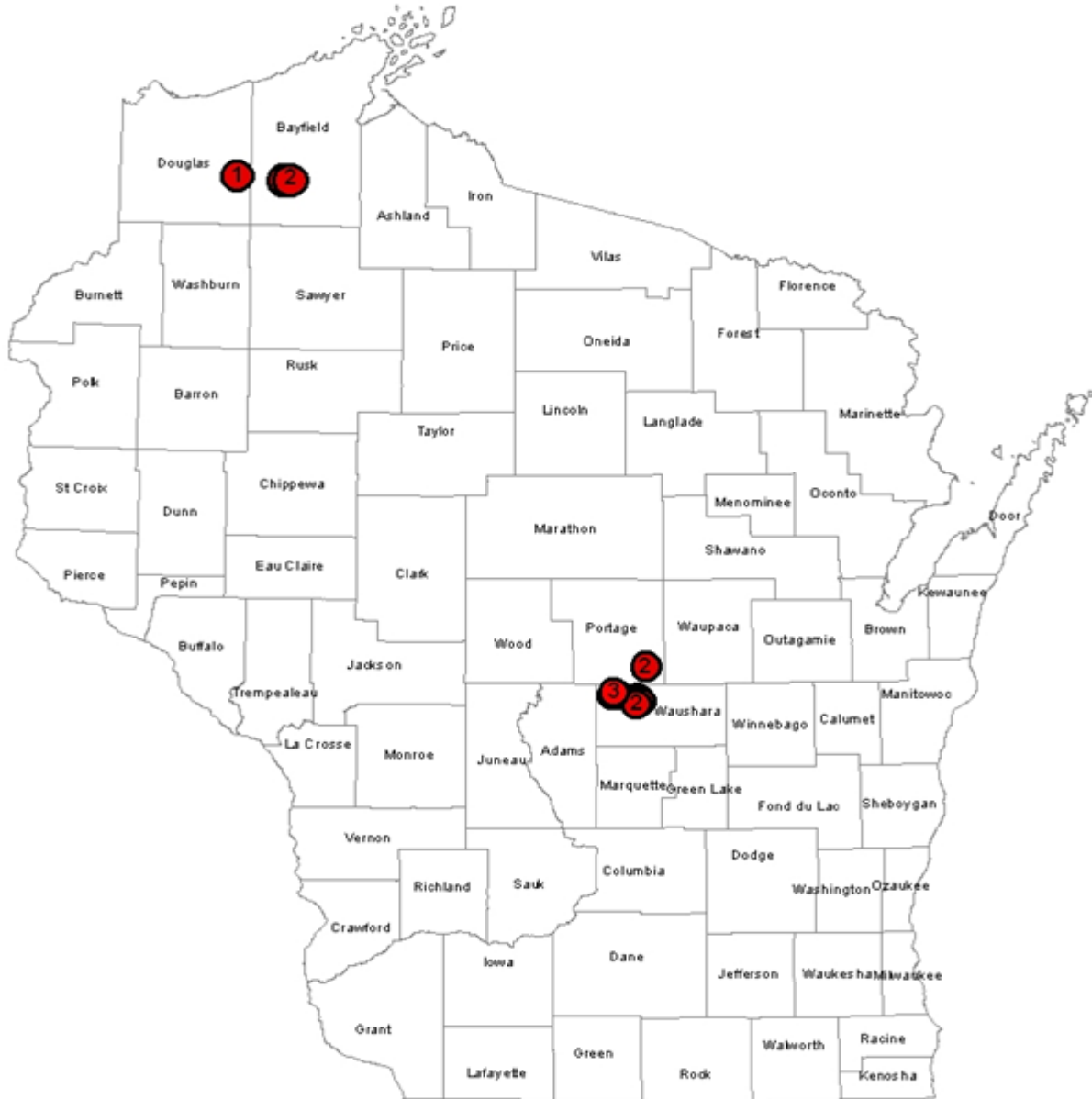
Of the 3 historic sites, Pigeon, Shumway, and Mud lakes, identified in the recovery plan (USFWS 1991), Fassett's locoweed was only rediscovered (in 1993) at Pigeon Lake in Bayfield County. No populations have been found at the Shumway and Mud lake sites in Waushara County despite repeated surveys since the late 1980s.

Three new Fassett's locoweed sites have been found in Wisconsin since completion of the recovery plan (USFWS 1991). Two of the new sites are in northwest Wisconsin; the Mountain Lake site found in 1992, and the Deer Print Lake site found in 2008. Deer Print Lake is located 20 km (12.4 miles) west of Pigeon Lake in Douglas County in a small cluster of sandy seepage lakes (Bushman 2011), reflecting a regional expansion of the species. Because the northwest Wisconsin sites are relatively close to Pigeon Lake [considered historic when the recovery plan (USFWS 1991) was completed], these populations do not reflect a significant change in the historic range of the species. However, the 3 sites in northwestern Wisconsin reflect an expansion of the extant range of Fassett's locoweed to northwest Wisconsin since completion of the recovery plan in 1991.

The third new site found since completion of the recovery plan (USFWS 1991) occurs at Wolf Lake in central Wisconsin (Portage County). One plant was observed here in 2005 with no plants sighted since. Wolf Lake is about 2 km (1.2 miles) from Pickerel Lake and represents a slight regional expansion of the range in central Wisconsin.

Figure 4 depicts the locations of the 10 currently extant Fassett's locoweed sites in Wisconsin; Pigeon, Mountain (Bayfield Co.), Deer Print (Douglas Co.), Plainfield, Second, Sherman (Marks), Weymouth, Huron (Waushara Co.), Wolf, and Pickerel (Portage Co.) lakes.

Figure 4. Ten extant Fassett's locoweed sites in Wisconsin as of 2012.



* Due to overlapping, the number of sites supporting extant occurrences of Fassett's locoweed within a given area is noted inside red circles. Two historical occurrences in Waushara county are not included on this map.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Fassett's locoweed is found on sandy-gravel lakeshores of seepage lakes, fed by groundwater, with fluctuating lake levels. Some shorelines have a high proportion of gravel. Fluctuating lake levels are critical in maintaining suitable open shoreline habitat for the species. Aggressive plant competitors may be eliminated during periods of high water. Fluctuating water levels also help maintain low substrate fertility (preferred by the species) and distribute seeds within the site. The amount of available habitat at each site depends on current and recent lake levels. Generally, lower lake levels expose more shoreline area which provides more suitable habitat for the species, resulting in higher population numbers, especially of seedlings. However, continued low water conditions may decrease habitat due to succession. High lake levels which eliminate shoreline habitat, generally reduce overall population numbers. In addition, water level fluctuations within seasons may cause mortality of plants through submersion or desiccation (Tracy Feldman, UW-SP, pers. comm., 2012).

Nearly all of the lakes that support Fassett's locoweed populations are less than 15 hectares (37.1 acres) in size and range in elevation from 350 to 370 meters (1214 feet) (USFWS 1991). These lakes are shallow, with the exception of Lake Huron. Beach slopes vary from gentle to moderately steep. Fassett's locoweed is found along the lakes on open shorelines and, to a lesser extent, on higher ground under the partial shade of adjacent vegetation. Fassett's locoweed occurs in areas that are completely exposed to sunlight or receive only partial shade from other species. The soil surface is subjected to extreme temperature fluctuations, high solar radiation, strong winds, and soil moisture stress. It is often in these areas, where competition from other plant species appears to be very low, that Fassett's locoweed occurs in the densest colonies (USFWS 1991). Feldman (2012) also reports that non-seedling plants occur in areas where competition is low. However, high density patches of Fassett's locoweed on Plainfield and Pickerel lakes also occur in areas of dense poplar (*Populus deltoids*), spotted knapweed (*Centaurea stoebe*), and white sweet clover (*Melilotus alba*). This may be because seedlings sometimes germinate abundantly under partial shade and may be more likely to establish where other plants (including invasive species) hold the soil together (Feldman 2011).

Due to the very low water levels in 2007-2010 at the central Wisconsin sites, suitable habitat may have been at a peak during those years. Populations at Plainfield and Pickerel lakes appeared to increase through 2012, although these increases are due to substantial increases in seedlings

and small plants that are often unlikely to survive, even as numbers of older, larger plants are decreasing (Feldman 2012).

It is important to monitor sites for invasive species and implement control measures as appropriate. However, it should be noted that Fassett's locoweed seedlings may be more likely to establish near established Fassett's locoweed plants and plants of other species (Feldman 2011); larger plants of many species, including invasive species (as noted above), may provide microclimates suitable for seedling establishment. Therefore, removal of invasive species should be done in a way that does not adversely affect any Fassett's locoweed plants that may be present, and consideration should be given to planting or encouraging growth of native species that may enhance seedling production.

2.3.1.7 Other:

General Fassett's locoweed information is available to the public at the following websites:

- the WDNR Bureau of Endangered Resources (BER) website at: <http://dnr.wi.gov/topic/endangeredresources/plants.asp?mode=detail&speccode=pdfab2x041> and
- the USFWS Midwest Ecological Services, Endangered Species website at: <http://www.fws.gov/midwest/endangered/plants/pdf/fassetts.pdf>.

Seed storage and viability studies

At least 1800 Fassett's locoweed seeds were collected in 2011 from Plainfield and Pickerel lakes, more than 1400 of which are now stored at the National Center for Genetic Resources Preservation in Fort Collins, Colorado. The remaining 400 were sent to Ann Rzepka Budziak for use in viability studies at the Holden Arboretum in Kirtland, Ohio (9500 Sperry Road, Kirtland, Ohio 44094). The plants resulting from these studies will be displayed in a garden at the Holden Arboretum that includes native habitats representative of those in the Great Lakes region (Ann Rzepka Budziak, pers. comm., 2012). In addition, somewhat less than 400 seeds [268 from soil cores (35 from Pickerel Lake and 233 from Plainfield Lake) and others from previous collections] have been deposited with the UW-SP herbarium (donated by Tracy Feldman, UW-SP in 2012).

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

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

A primary threat to Fassett's locoweed identified in the recovery plan (USFWS 1991) was development. This threat has been reduced. As reviewed in the 2009 5-year review of Fassett's locoweed (USFWS 2009), fee simple title has been acquired for several properties at Fassett's locoweed sites in central Wisconsin by the WDNR SNA Program. Within the last five years the SNA Program completed the purchase of a large portion of Plainfield Lake and is continuing to negotiate protection of Weymouth Lake (Darcy Kind, *in litt.* 2008). Several of the properties with Fassett's locoweed are included in the Plainfield Tunnel Channel Lakes and Pickerel Lake SNAs. Mountain Lake is part of the USFS's Chequamegon-Nicolet National Forest and was designated a SNA in 2007. WDNR staff continues to collaborate with interested landowners on the remaining sites to promote conservation of the species and sites. Protective signage is in place at several sites, although the presence of Fassett's locoweed is not advertised in order to protect the species from human disturbance (Craig Anderson, pers. comm., 2008) (Steven Spickerman, USFS, pers. comm., 2008). SNA signs occur at the lakes of the Plainfield Tunnel Channel Lakes SNA (Plainfield, Second, and Sherman lakes). There are SNA boundary signs on the northwest part of the Pickerel Lake SNA, and additional signs prohibiting campfires and littering have been installed at the public boat landing at the southeast corner of the lake. Fassett's locoweed sites on designated SNAs are protected because designation provides a significant level of land protection through state statutes, administrative rules, and guidelines. SNAs are managed to maintain native landscapes, helping to preserve Fassett's locoweed habitat. Maps and information on SNA can be found at the following WDNR website: <http://dnr.wi.gov/topic/Lands/naturalareas/>.

The recovery plan identified the use of the county boat ramp on Pickerel Lake as a potential threat as well as fishing, hiking, and swimming in this area (USFWS 1991, p. 20). Camp Helen Brockman also occurs on Pickerel Lake. In the past, Fassett's locoweed areas on camp property had been roped off (Darcy Kind, pers. comm., 2012), however no ropes were in place as of at least 2009. It is important to continue to monitor activities on this lake and work with landowners and managers on measures to protect Fassett's locoweed habitat.

At Lake Huron, recreational use of the shoreline and residential development remains a threat, although lake residents have caged plants on the public shoreline and some of the private shorelines nearby

(Feldman, pers. obs. 2011) to prevent trampling or inadvertent mowing (WDNR 2008). Residents have taught other residents how to identify Fassett's locoweed (also distributing fact sheets), so they can monitor and protect plants they find, as well as monitor and occasionally pull invasive plants on the lake, and keep people from using vehicles on the lake shore (Don Walczak, pers. comm., 2012).

Private landowners have been great resources for monitoring and protecting Fassett's locoweed. Many landowners on Huron, Plainfield, and Pigeon lakes have either passively or actively supported protection of Fassett's locoweed on those lakes, have kept vehicles off of lake shores, and have helped monitor plants on the lakes. The lake associations on Huron and Pigeon lakes support these efforts (Darcy Kind, pers. comm., 2012). Residents around Wolf and Pickerel lakes are also supportive of protection efforts (Nancy Turyk, pers. comm., 2012).

A study is underway through UW-SP extension (Center for Watershed Education and Management) involving 33 lakes in Waushara County, including Lake Huron and Plainfield Lake. The study includes collecting data on hydrology, wetland delineation, and water quality and working with the communities around these lakes to produce lake management plans (Nancy Turyk, pers. comm., 2012).

In 2009, a management plan was drafted (not yet final) by the Wolf, Fountain, and Pickerel Lake Management Planning Committee (WFPLMPC). The plan recommends monitoring of Fassett's locoweed populations and additional surveys on Pickerel and Wolf lakes (one Fassett's locoweed plant was found at Wolf Lake in 2005), as well as removal/treatment of invasive species (WFPLMPC 2009). Another management plan for lakes in Waushara County, including Lake Huron, is now under development and may be drafted in one more year (Nancy Turyk, pers. comm., 2012).

The Fassett's locoweed recovery plan (USFWS 1991) identified nutrient enrichment of shorelines supporting Fassett's locoweed resulting from run-off as a threat, as this may result in loss of habitat due to competition from other plant species that would not typically be able to compete with Fassett's locoweed in its nutrient poor habitat. Further assessment of this threat should be done, especially at lakes that support homes or camps, or are near agricultural fields.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

As stated in the previous 5-year review for Fassett's locoweed (USFWS 2009), there has been no past or current overutilization of Fassett's

locoweed plants for commercial, recreational, scientific or educational purposes. Various studies have included collection of plant parts or seeds, however these collections have not threatened populations. Seeds from Fassett's locoweed were sent to the Holden Arboretum for curation and germination studies in 1986 (Parsons 1989). Chung (2001) collected leaves of Fassett's locoweed for genetic analysis. Feldman (2009) collected seeds of Fassett's locoweed for experiments on germination. In addition, UW-SP students used Plainfield and Pickerel lakes as sites for plant ecology labs (Feldman 2009, 2010, 2011, 2012). The students collected soil cores at least 25 cm (9.8 inches) away from germinated plants, to examine the density of seeds in the soil in different locations. In 2011, seeds from Plainfield and Pickerel lakes were collected for storage and viability studies at the Holden Arboretum in Kirtland, Ohio (refer to section 2.3.1.7, "Seed storage and viability studies" above). Commercial taking does not appear to be a threat to Fassett's locoweed because it is not known to be used for any commercial or recreational purposes.

2.3.2.3 Disease or predation:

The Fassett's locoweed recovery plan (USFWS 1991) identified the potential failure of the species seed crop due to disease or predation as a potential threat (USFWS 1991, p. 14). Currently disease does not appear to be a significant threat. No diseases are presently known to affect Fassett's locoweed populations. However, herbivory has occasionally been reported. One surveyor noted in 2006 and 2007 that flowers were eaten from a number of plants at one site, possibly by deer (WDNR, unpublished data). At Plainfield and Pickerel lakes in 2009-2012, Feldman observed racemes removed from Fassett's locoweed plants, potentially by deer. Monitoring should include assessment of this threat, especially herbivory on flowering and fruiting stems of the plant (Dr. Robert Freckmann, *in litt.* 2008) and measures taken to reduce the threat, such as fencing, if the viability of the population is threatened. Insect herbivores may also affect Fassett's locoweed plants and seeds. At Plainfield and Pickerel lakes between 2009 and 2012, Tracy Feldman (UW-SP) observed caterpillars on racemes, spittlebugs on leaves, and occasional chewed leaves or racemes. At Pickerel Lake in 2012 he also observed holes in mature Fassett's locoweed fruits, reminiscent of weevil damage. Monitoring should include assessment of insect as well as mammal herbivory on Fassett's locoweed leaves, fruits, and seeds.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Inadequacy of existing regulatory mechanisms was not identified as a threat in the recovery plan (USFWS 1991). As noted in the 2009 5-year review of Fassett's locoweed (USFWS 2009), the species is listed as endangered by the State and federally-listed as threatened. The Wisconsin Endangered Species Act (ESA) (State Statute 29.604) and

Federal ESA provide some protection for listed plant species on public, including Federal, lands. The State ESA prohibits the processing and selling of listed plants. While the State and Federal regulatory protections on private lands are limited, the WDNR has contacted private landowners advising them of the presence of Fassett's locoweed on their land and its conservation needs. Destruction of Fassett's locoweed by private landowners does not appear to be a significant threat, but it still occasionally occurs (e.g., mowing of Fassett's locoweed at Pigeon Lake, refer to section 2.3.2.5 below). All Federal and state landowners (USFS and WDNR) of occupied Fassett's locoweed sites are aware of the plant locations within their jurisdiction and take measures to protect them, although more protective signage may be needed (refer to section 2.3.2.5 below). Fassett's locoweed populations that occur below the ordinary high water mark may be under state ownership and therefore protected via the State Endangered Species statute (Darcy Kind, in litt. 2008, C. Anderson, pers. comm. 2008).

Federal agencies must consult with the USFWS on any actions that may affect Fassett's locoweed pursuant to section 7 of the ESA. The USFS Chequamegon-Nicolet National Forest consulted with the USFWS on use of herbicides to control Canada thistle at Pigeon Lake (USFWS 2009). In 2012, because of the increasing threat from the Canada thistle at Pigeon Lake, the USFS consulted with the USFWS on the use of herbicides (Milestone VM) to control the thistle. To preclude adverse effects to Fassett's locoweed, no herbicides will be used within 15 feet of known locoweed plants. Between 15 and 68 feet of known locoweed sites, herbicides will be applied via glove, brush, wick, or sponge application. Backpack spraying of herbicides will only occur beyond 68 feet of a locoweed site when wind conditions are low (less than 5 mph). Work at all sites will be done by knowledgeable personnel skilled in the identification of locoweed and Canada thistle (USFWS, in litt., 2012) (USFS, in litt., 2012).

It appears that there is not an effective regulatory mechanisms to address the threat of lowering water levels due to high capacity well pumping (refer to section 2.3.2.5 below), making it important to pursue protections such as identification and securing of the groundwater contribution areas for at least central Wisconsin sites and possibly installing a well to augment water levels at Plainfield and Second lakes (refer to 4. Recommendations for Future Actions, Actions to Address Threats Due to Continued Low Lake Levels below).

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Threats identified in the Fassett's locoweed recovery plan (USFWS 1991) included high capacity wells used for row crop irrigation that could affect groundwater levels and thus lake level fluctuations important to maintaining Fassett's locoweed populations. The recovery plan (USFWS 1991) also identified herbicide drift or run-off from agricultural and residential uses as a threat, especially if the protective wooded buffer around these lakes decreased resulting in increased overland flow of sediment laden run-off into the lakes supporting the species.

The threats identified above are on-going. Weeks and Strangland (1971) noted that streams and groundwater levels were affected to some extent by irrigation development, and that irrigation was developed extensively in the Plainfield area in the late 1940s. An analysis of factors affecting groundwater levels in central Wisconsin conducted by the WDNR, University of Wisconsin-Extension, and Wisconsin Association of Lakes (Kraft et al. 2010) found that water levels in central Wisconsin lakes had dropped by more than one meter over the last decade due to high-capacity pumping wells, whose numbers have increased through time. This study suggests two potential threats of high-capacity pumping wells to Fassett's locoweed populations: 1) long-term habitat loss through encroachment of hetero-specific (other) plant species on the upper lake shores, and 2) desiccation of Fassett's locoweed plants as lake levels fall during droughty growing seasons (Feldman 2011, 2012). Estimates by Feldman (2012) suggests that at least 20% of the area at Plainfield Lake and 25% of the area at Pickerel Lake could be lost from high capacity well pumping.

Climate change may exacerbate (make worse) the adverse effects of fluctuating water levels on Fassett's locoweed plants by causing more frequent floods and droughts in the Midwest (United States Global Change Research Program 2009). Droughts may adversely affect Fassett's locoweed by drying the seepage lakes that support the species, resulting in desiccation of Fassett's locoweed plants, especially seedlings and small plants, as well as greater threats from invasive nuisance plants. Both of these threats would cause reductions in population numbers. Flooding may drown out plants, reducing population numbers. Past lake level monitoring at Lake Huron indicated that the lake was at the lowest level measured since monitoring began in 1973 (Roost and Cason 2007).

There have been no affects observed on Fassett's locoweed plants from herbicide use, although pesticides used in potato fields near occupied lakes may be a threat. Soils in central Wisconsin are sandy, allowing contaminants to enter the groundwater and nearby seepage lakes thereby creating the potential to expose Fassett's locoweed to these pesticides (David Kopitzke, *in litt.* 2008).

Mechanical management and/or use of herbicides to control aquatic invasive plants including Eurasian water-milfoil (*Myriophyllum spicatum*), curly-leaf pond weed (*Potamogeton crispus*), and purple loosestrife (*Lythrum salicaria*) could potentially threaten Fassett's locoweed populations, especially on lakes with boat traffic (Darcy Kind, in litt. 2008). The herbicides 2, 4-D, and diquat bromide have been used on Pickerel Lake and Lake Huron, respectively to control Eurasian water milfoil (in 2000-2006 and 2008-2012) (Eric Evenson, WDNR, pers. comm., 2012). Herbicides were selected based on their short half-life and were directly injected into the water (Scott Provost, WDNR, pers. comm., 2012). WDNR reviews and approves control methods for water-milfoil on Lake Huron, designing such projects to avoid and minimize harm to Fassett's locoweed (WDNR, in litt. 2003).

Other invasive species that may threaten Fassett's locoweed and/or its habitat spotted knapweed (*Centaurea stoebe*), reed canary grass (*Phalaris arundinacea*), Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), butter-and-eggs (*Linaria vulgaris*), eastern cottonwood (*Populus deltoides*), and non-native yellow hawkweeds (*Hieracium* and *Crepis* species). These species have been monitored at several sites, and some nonnative species have been hand-pulled on publicly-owned sites (WDNR 2008). In 2011, eastern cottonwood was cut and stems were treated with Garlon 3A at Plainfield Lake. In summer 2012 at Pickerel Lake, between 10 and 20 weevils (biocontrol agents) were released to control spotted knapweed (probably *Larinus* spp. or spotted-knapweed seed head weevils) (Nancy Turyk, pers. comm., 2012). Nonnative plant species on Plainfield and Pickerel lakes have been mapped (Almasi 2007; Feldman 2009, 2010, 2011, 2012). Invasive species (mainly Canada thistle, spotted knapweed, and bull thistle) have been hand pulled at Mountain and Pigeon lakes by the USFS for the past five years (2008-2012) (Matt Bushman, USFWS, pers. communication, 2013).

Populations of invasive species are very large and dense at some sites. Almasi (2006) recommended that invasive species be tightly monitored and controlled when possible at Pickerel and Plainfield lakes. However, Feldman (2011, 2012) recommended that the effects of invasive species on Fassett's locoweed should be tested rigorously, as some invasives may positively affect Fassett's locoweed plants, at least at some life stages by providing microclimates suitable for seedling development (refer to section 2.3.1.6). Management at Mountain and Pigeon lakes includes control of invasive species (refer to section 2.3.2.4 above). Researchers should record the location and density of invasive species that are being removed. Monitoring and controlling invasive plant species should continue at all sites and include searches for potential new invasive species as yet unrecorded from occupied sites or nearby areas (Darcy Kind, in litt. 2008).

Threats to the species and its habitat from private landowner actions (e.g., vehicular or pedestrian traffic) still exist but are being reduced in some areas. The private landowner on Mountain Lake has been informed of the presence of the species on their property. At least one landowner on Pigeon Lake is protecting the species. However, the WDNR is aware of another landowner on that lake who mowed Fassett's locoweed plants. The land around Deer Print Lake is owned by Lyme St. Croix Forest Company LLC, but these owners have not yet been approached about Fassett's locoweed (Matt Bushman, pers. comm., 2012). Additional landowner contact to secure protection of Fassett's locoweed and its habitat is needed.

All-terrain vehicle (ATV) use threatens habitat at some locations. The USFS had a sign prohibiting ATV use at Mountain Lake in the past (Steven Spickerman, pers. comm., 2008), but signage is no longer in place as ATV use is currently not a threat at this lake. An ATV was driven through Fassett's locoweed areas on Plainfield Lake in 2012 (Tracy Feldman, UW-SP, pers. comm., 2012); the WDNR warden is aware of the incident and will periodically check the site (Thomas Meyer, WDNR, pers. comm., 2012).

2.4 Synthesis

Fassett's locoweed is a rare endemic currently known from 10 sites that occur in two widely geographically separated clusters of seepage lakes in Wisconsin (Figure 4 and Appendix B). Seven of the populations occur in central Wisconsin and are separated from the three northern sites by 240 km (149 miles). Since 2008, only two very small new Fassett's locoweed populations have been found at Deer Print Lake in northwest Wisconsin and Wolf Lake in central Wisconsin. Because Wolf Lake and Deer Print Lake sites are relatively close to other extant sites, the sites reflect a slight regional range expansion in both central and northwest Wisconsin but do not reflect a significant change in the historic species range. However, the three sites in northwestern Wisconsin (Pigeon, Mountain and Deer Print lakes) do reflect an expansion of the extant range of Fassett's locoweed to northwest Wisconsin since completion of the recovery plan (USFWS 1991) (refer to section 2.3.1.5).

Of the 10 lakes that support Fassett's locoweed, the plant currently occurs in highest numbers (thousands) at four lakes; Pigeon, Mountain, Plainfield, and Pickerel lakes. Populations of Fassett's locoweed have fluctuated considerably over time (refer to Figures 1-3 and Appendix A). From 2009 to 2012, populations at Plainfield and Pickerel lakes have been stable or increasing (Figure 1) due to increases in the number of seedlings (in the thousands) and small plants (Appendix A, Tables 1 and 2), most of which do not survive long enough to reproduce (Feldman 2009, 2010, 2011, 2012). Numbers of reproductive plants have decreased over the last four years at these two lakes. Predictions using projection matrix population models indicate that these populations have the potential to decrease in the near future (Feldman 2012), making

future surveys important to assess changes in the population status at lakes with high numbers of seedlings. Up to 2000 plants were observed at Second Lake from 2006-2008, however the current population level is unknown. Lesser numbers of plants occur at Weymouth and Sherman (Marks) lakes (populations generally number in the hundreds). Very small populations (30 plants or less) have been consistently recorded at Lake Huron, Deer Print Lake, and Wolf Lake (Appendix A, Tables A1 and A2). More current survey information is needed to assess the current population status of Fassett's locoweed at Second and Sherman (Marks) lakes.

While none of the threats to the species have been removed since listing, some have been reduced, i.e., site protection is in place in whole or part for seven sites (refer to Appendix B), and there are active monitoring and management programs in place. However, while efforts are being made, invasive species and vegetative succession of shoreline areas to shrubs and trees remain serious threats, especially during low water years (refer to section 2.3.1.6). ATV use and mowing threaten at least two sites. High-capacity pumping wells are an increasing threat. The number of such wells has increased in central Wisconsin and have lowered groundwater levels more than one meter (Kraft et al. 2010). These wells likely exacerbate low water levels related to drought within a season at lakes supporting Fassett's locoweed and are anticipated to contribute to more long-term habitat losses related to climate change. Climate change is a significant and increasing threat (refer to section 2.3.2.5). Ongoing studies assessing factors affecting groundwater levels, including climate change and high capacity well pumping in central Wisconsin are critical to our understanding of how groundwater levels may impact Fassett's locoweed populations in the future. Insect and deer herbivory are on-going but less significant threats to the species. While many of the Fassett's locoweed sites or portions of them are in State or Federal ownership (refer to Appendix B), continued effort is needed by WDNR and USFS staff to collaborate with public landowners to promote conservation of the species and additional land protection is needed.

No change in classification is warranted. Recovery efforts should continue with the goal of establishing stable, self-reproducing, multiple, viable populations in both northwestern and central Wisconsin. Efforts should continue to secure the highest level of protection for all populations with a focus on those without any lands in State or Federal ownership. Based on the level of threats, including those related to climate change and invasive species (refer to above), low number of extant populations (10) and population numbers (refer to above), this species may become endangered in the foreseeable future throughout all or a significant portion of its range, and therefore continues to meet the definition of threatened.

3.0 RESULTS

3.1 Recommended Classification: Threatened, no change is needed

3.2 New Recovery Priority Number: NA (no change, remains 9)

3.3 Listing and Reclassification Priority Number: NA

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

The following recommendations for future actions include those identified in the 2009 5-year review for Fassett's locoweed (USFWS 2009) that are still pertinent as well as additional actions considered important for the recovery of the species.

Note: the recovery "Action" numbers noted in the text below e.g., "Action No. 1," refer to recovery actions identified in the Fassett's locoweed recovery plan (USFWS 1991).

Land protection and site monitoring

Implementation of the recovery actions identified in the Fassett's Locoweed recovery plan (USFWS 1991) should continue with the highest priority action being to secure the strongest level of land protection at extant sites; this would address recovery Action No.1(Protect lakeshores with populations of Fassett's locoweed in all cases pursuing the strongest, appropriate method). Monitoring and management of Fassett's locoweed sites should continue annually; this addresses recovery Action Nos. 2 and 3 (Develop and initiate management activities and monitor populations), giving special emphasis to the control of invasive species and encroachment of woody species (refer to section 2.3.1.6 above for guidance).

Site protection

It is important to continue to encourage and involve private landowner participation in protection of Fassett's locoweed and its habitat. This is especially important for sites where portions of the lakes are in private ownership e.g., Pigeon, Wolf, and Deer Print lakes, and Lake Huron where the landowner may not be aware of the presence of species (refer to section 2.3.2.1 above). Obtaining the interest and participation of landowners or other conservation minded groups to help with management activities will address recovery Action No. 2.

The need for fencing to reduce deer herbivory should be assessed and if reasonable, areas at risk of losing viable populations should be fenced.

Population monitoring at Plainfield and Pickerel lakes

It is important to continue population monitoring at Plainfield and Pickerel lakes, and to continue measuring marked plants, to further develop the projection matrix model used to predict future population trends at these lakes. Recording data on survival, growth, and reproduction from marked plants, combined with seed bank studies (refer to below), are both essential for parameterizing this model. It will also be important to incorporate temporal and environmental stochasticity into population models so predictions of population viability can account for demographic changes caused by fluctuating water levels.

Population augmentation

An assessment should be made to determine the best places for augmenting populations of Fassett's locoweed and an augmentation program started. For example population augmentation

could be considered at extant sites with very low population numbers providing habitat conditions and management suitable to help secure viable populations, such as at Wolf Lake in central Wisconsin. While the previous Fassett's locoweed 5-year review (USFWS 2009) recommended that population augmentation be considered at Pigeon Lake due to low population numbers, augmentation is no longer needed here as the population expanded significantly in 2009 due to lowered water levels (refer to Appendix A, Table A2).

Searches for new sites and potential reintroductions

Searches for new sites should continue. This will address recovery Action No. 4 (Resurvey lakeshores with historic populations and those with potential habitat during years of low lake levels). The discovery of the populations at Pigeon, Deer Print, and Wolf lakes suggest that seeds may persist under water for many years, so lakes with high water levels now may reveal populations in the future if water levels decrease. Future surveys should continue at lakes with and without historic populations and be conducted in years when water levels are low (past surveys were not consistent in this respect) (refer to section 2.3.1.2).

If no new sites can be found, consideration should be given to the feasibility and appropriateness of reintroducing the species to historic sites or to introductions at sites with suitable habitat within the potential range of the species; this would address recovery Action No. 7 (Consider introducing propagules of Fassett's Locoweed at locations without extant populations but appropriate habitat if adequate conservation cannot be achieved through protection of naturally-occurring populations).

Protecting and managing reintroduced or introduced populations would help buffer against large-scale stochastic variation such as regional variation in weather, hydrology, or catastrophic disturbance. New sites in northern Wisconsin, protected and managed, may help reduce the vulnerability of Fassett's locoweed populations to climate change. The USFWS's guidance on "Controlled Propagation of Species Listed under the ESA" (2000) should be followed (as appropriate) when developing reintroduction/introduction plans. When conducting reintroductions or introductions, only northern populations should be transplanted to northern sites and southern populations to southern sites (E. Judziewicz, *in litt.* 2008). Augmentation, reintroduction, or introduction programs should incorporate research on seed germination and viability studies, as such studies would be beneficial (R. Freckmann, *in litt.* 2008). In addition, it should be determined whether *Rhizobium* bacteria and/or arbuscular mycorrhizal fungi are associated with Fassett's locoweed. These studies will require sampling of live material as evidence of interactions may degrade after plants die (Tracy Feldman, UW-SP, pers. obs., 2012).

Actions to address threats due to continued low lake levels

To address the threat of lowering lake levels in central Wisconsin that support Fassett's locoweed, WDNR should consider installing a well to facilitate water level fluctuations at Plainfield and Second lakes; the lakes are hydrologically connected. According to Thomas Meyer (WDNR, pers. comm., 2012) this may be a means of maintaining viable Fassett's locoweed populations at these lakes over the long term. Lowering water levels in central Wisconsin are likely associated with pumping from high capacity wells (refer to section 2.3.2.5)

exacerbated by global climate change. Installing a well to maintain lake level fluctuations would help address the need to develop and initiate management necessary to maintain populations (recovery Action No.2).

The ground watersheds of the lakes supporting Fassett's locoweed should be mapped. If unknown, studies should be conducted to identify the ground watersheds. The results should be used to help guide further protection efforts. Installation of monitoring wells on lakes supporting Fassett's locoweed is recommended to document the natural lake level fluctuations. This information could be used to determine when lakes may need to be augmented by an outside water source (well) to maintain such fluctuations and preclude the loss of the species at those lakes. These actions would help address recovery Action No. 65 (Determine the location of high capacity wells and their relationship to groundwater basins for lakes with populations of Fassett's locoweed).

Pollinator studies

More definitive work should be done to characterize the pollinators of Fassett's locoweed in various locations and times during the blooming period to address recovery Action No. 63 (Determine the breeding systems of Fassett's locoweed), and to investigate the effects of competition from nonnative as well as native plants on the species (recovery Action No. 64). When Fassett's locoweed blooms at lower densities, other co-occurring plant species may be more likely to either draw pollinating insects away from Fassett's locoweed (competition for pollinators), or to attract pollinating insects to Fassett's locoweed plants (facilitation of pollination). It is important to understand how reproductive success changes as a function of blooming time, as Fassett's locoweed individuals can bloom at any time between May and November (Tracy Feldman, pers. obs., 2009-2012), in order to determine if phenology is synchronized with that of pollinators.

Seed storage

In the future, more Fassett's locoweed seeds should be collected from more populations than Plainfield and Pickerel lakes (if the populations are sufficiently large) for permanent storage at approved seed storage facilities. This will help protect against possible adverse effects to the species due to climate change or losses due to other causes (refer to section 2.3.1.7).

Seed bank studies

Population modeling has indicated that the population growth rate was most affected by changes in seed survival and seed production. Therefore persistence of Fassett's locoweed populations is likely dependent upon the seed bank (Feldman 2010, 2011, 2012). Understanding the extent of the seed bank in the soil, how long seeds remain there, and the cues that allow for germination may offer valuable insights about what allows these populations to persist and the status of individual populations. The seed bank studies below would address recovery Action No. 61 (Examine the role of seed bank in population maintenance), and No. 612 (Study seed characteristics to determine dispersal mechanisms, longevity, and dormancy and germination requirements).

To understand the seed bank, information is needed on the extent of the seed bank in the soil in a natural population, the rate at which seeds enter the seed bank (by dispersing into the soil) and the rate at which seeds of different ages transition out of the seed bank (by germinating). To estimate the size and distribution of the seed bank, it is important to collect more soil cores over broader areas on the lake shores (than done by Feldman 2008-2012), as well as to conduct surface counts of seeds collected from quadrats [e.g., 25 x 25 cm (9.8 x 9.8 inches) quadrats] in several locations along the shoreline. This will help estimate the size of the seed bank, and if the locations are along permanent transects, the seed bank can be mapped (at least crudely).

To understand the rate at which seeds naturally germinate once they enter the seed bank, it is important to test the hypothesis that damage to the seed coat through gradual wear from freezing and thawing and contact with sand allows for seeds to germinate. This idea is supported by very high (80-95%) rates of germination success once seed coats of Fassett's locoweed seeds are nicked with razor blades, even if these seeds are several years old (Feldman 2011, 2012). Mock seed banks (different than the ones used by Feldman 2009) can be used to estimate the rate at which seeds leave the seed bank. If numbers of reproductive plants are sufficiently large in a given population, seeds could be collected for use in mock seed banks, dividing seeds into several mesh packages (made of window-screen), mixing genotypes among each replicate, and burying them in the soil for several seasons. Each season, a subset of the seeds from these mock seed banks can be removed to test for seed viability and germination rates (germination rates with and without nicking the seed coat first). This might help in understanding mortality rates due to fungi and other microbes. To better understand seed mortality prior to dispersal, frugivory (damage from fruit-eating animals) and seed predation of fruits should be estimated.

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APPENDIX A

Summary Information on Fassett's Locoweed Sites in Wisconsin

Table A1. Fassett's locoweed population estimates for 8 sites in Wisconsin, 2009-2012.

Site	Pickereel 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
Notes	Contact with private landowners including Camp Helen Brockman should continue to protect FL plants. Water Levels rose in 2011-12. Threats include foot and vehicle traffic along with invasive spp.	Water levels very low in 2005-2010, and two sandbar islands visible with FL plants. Water levels rose in 2011, then fell again during summer 2012. Threats include low water levels, foot and ATV traffic, and invasive species.	Water levels very low in 2005-10. Water levels rose in 2011, then fell again during summer 2012.	Located immediately S of Second Lake with a low ridge of trees between them. This lake was nearly dry in 2005.	Located E and S of Second Lake; low water level observed in 2012 (Thomas Meyer, pers. comm., 2012).	Deepest of local channel lakes; multiple private owners. Contact with private landowners should continue.	Plant numbers dramatically increased since 2009 when water levels dropped. Lake levels higher in 2012 than in 2010; competition increasing from other native plants. Mowing of FL on the shoreline a threat.	ATV use at this site no longer a threat; adjacent landowners contacted. Population stable.
2012	32104±4905.1 seedlings (mean±SE); 1369±203.04 non-reproductive plants; 901±160.1 reproductive plants (>29,000 plants).	274820±17533 seedlings (mean±SE); 12667±1341.1 non-reproductive plants; 384±87.37 reproductive plants (>268,000 plants).	56 seedlings, 37 non-reproductive plants, and 14 reproductive plants (107 plants), mostly on the NE shore, but a few on the SW shore (partial survey) (Cathy Carnes, USFWS, in litt., 2012).	< 10 plants observed, no survey conducted (Cathy Carnes, USFWS, in litt., 2012).	100's of plants, primarily in a dense patch on the N shore (Tracy Feldman, UW-SP, pers. comm., 2012).	2 reproductive plants and approximately 20 seedlings on the W shore. Plants on the N shore died (Don Walczak, pers. comm., 2012).	Approximately 125,000 plants.	Approximately 5000 plants. Some dying on the upper shore, and more seedlings on the lower shore.

Site	Pickereel 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
2011	16744±3865.6 seedlings (mean±SE); 2700±352.52 non-reproductive plants; 3108±387.5 reproductive plants (>17,000 plants).	87987±9339.7 seedlings (mean±SE); 5124±434.71 non-reproductive plants; 1963±309.95 reproductive plants (>85,000 plants).					Approximately 400,000 plants.	Approximately 5000 plants.
2010	8709±1550.3 seedlings (mean±SE); 6264±716.09 non-reproductive plants; 2293±249.19 reproductive plants (>14,000 plants).	18995±2363.7 seedlings (mean±SE); 32226±2684.9 non-reproductive plants; 29285±2790.9 reproductive plants (>72,000 plants).					Approximately 400,000 plants	Approximately 5000 plants.
2009	1098.1±481.93 seedlings (mean±SE); 8891±2897.6 non-reproductive plants; 12675±2385.6 reproductive plants (>16,000 plants).	33179±3788.1 seedlings (mean±SE); 38387±2997.9 non-reproductive plants; 57514±5055.7 reproductive plants (>117,000 plants).					Approximately 100,000 plants.	Approximately 5000 plants.

Data for Pigeon and Mountain lakes from Bushman (2011) and Matt Bushman (USFS pers. comm., 2012).

Data for Pickerel and Plainfield lakes from Feldman (2009, 2010, 2011, 2012) .

Data from following sites not included on above table as sites are historic or little data is available:

- Mud and Shumway lakes (Waushara County): historic sites.
- Wolf Lake (Portage County): one plant observed in 2005 only (Patty Dreier, Portage County, 2012); photo of 2005 plant in UW-SP herbarium (Robert Freckmann, UW-SP, 2012); no plants seen since 2005.
- Deer Print Lake (Douglas County): 8 plants found in 2008 when site discovered (Joshua Horky, pers. comm., 2008), 7 plants (1 adult and 6 juveniles) found in 2009 (Kevin Doyle, WDNR, pers. comm., 2012), 7 plants found in 2010 (Bushman 2010).

FL = Fassett's locoweed SE = Standard error

A summary of FL data dating from 1928 to 2008 can be found in the 2009 FL 5-YR Review, Appendix A (USFWS 2009)

Table A2. Estimates of Fassett's locoweed populations from Table A1 used to derive Figures 1-3^{a, b}.

Lake County	Pickerel Portage	Plainfield Waushara	Second Waushara	Sherman Waushara	Weymouth Waushara	Huron Waushara	Pigeon Bayfield	Mountain Bayfield
Year								
1989	100	200,000	2,000		400	100		
1990								
1991								
1992								591 ^c
1993							1	
1994		19 ^c			21 ^c	12 ^c		
1995		1			20	11		
1996					15			12
1997		1						
1998	4	9,400			100			
1999		5,000						
2000	1,000	4,000 ^d		13 ^{c, d}				
2001	1	7,500 ^d	50			26	0	1,000 ^c
2002	75	3,000			1,500	23		1,000 ^c
2003								
2004	500	200,000	100		350	10		
2005	800	200,000	0		650	17		400
2006	28,211	202,873	2,000	500	1,650	20	2	800
2007	25,701	125,808	2,000	250	290	30	2	1,000
2008 ^e	28,000	60,000	2,053	240		19		1,000
2009	16,000	117,000					100,000	5,000
2010	14,000	72,000					400,000	5,000
2011	17,000	85,000				15	400,000	5,000
2012	29,000	268,000	107 ^f	10 ^f	200	22	125,000	5,000

^a Four sites have been excluded from the table: two historic sites where Fassett's locoweed has not been found in several decades (Mud Lake and Shumway Lake), Deer Print Lake and Wolf Lake (refer to notes at bottom of Table A2).

^b Blank spaces denote years and lakes for which no surveys were conducted.

^c Indicates clumps of plants (noted in Table A1) which are treated as individual plants in Figures 1-3.

^d Indicates midpoints of population ranges noted in Table A1.

^e Last year of data (2008) included in the 2009 Fassett's locoweed 5-year review (USFWS 2009); data below the line is new data since that review.

^f These estimates were derived from partial surveys during which only small portions of the lake shore were surveyed.

APPENDIX B

Ownership of Fassett's Locoweed Sites, Including Two Historic Sites

Lake	County	Ownership	Notes
<u>CENTRAL WI</u>			
Mud ^a	Waushara	Private	Historic site--no plants have been found since 1939.
Shumway ^a	Waushara	Private	Historic site--no plants have been found since 1978.
Huron ^b	Waushara	Multiple Private	Plants are monitored by the landowners around the lake. Plants are caged.
Plainfield ^b	Waushara	WDNR, private	Part of Plainfield Tunnel Channel Lakes SNA protected in 1990. Much of the FL population is protected by being in a SNA. More plants occur to the N on private land.
Second ^b	Waushara	WDNR, private	Part of Plainfield Tunnel Channel Lakes SNA protected in 1990.
Sherman (Marks) ^b	Waushara	WDNR, private	Part of Plainfield Tunnel Channel Lakes SNA protected in 1990.
Weymouth ^b	Waushara	WDNR, private	Part of Plainfield Tunnel Channel Lakes SNA protected in 2010. No FL occurs in the protected area. Permanent protection should be sought for remainder of this site.
Pickerel ^b	Portage	WDNR, private	Much of the FL population is protected by being in a SNA. A great number of plants remain on private property. A summer camp (Camp Helen Brachman) uses the beach where the plants are located. The owner (Daryl Woods) is interested in protecting the plants (Tracy Feldman, pers. comm., 2009-2012).
Wolf ^c	Portage	Portage County, private	No plants found since 2005.

Lake	County	Ownership	Notes
<u>NORTHWEST WI</u>			
Pigeon ^d		University of Wisconsin System, USFS-Chequamegon-Nicolet National Forest, private	Landowner contact should continue with adjacent private landowner.
Mountain ^c	Bayfield	USFS -Chequamegon-Nicolet National Forest, private	All of population located on USFS land. Contact should continue with adjacent private landowner.
Deer Print ^c	Douglas	Lyme St. Croix Forest Company LLC (private company)	Landowners should be contacted regarding Fassett's locoweed.

^a Historic sites

^b Extant sites when recovery plan completed (USFWS 1991).

^c Sites found since completion of recovery plan (USFWS 1991).

^d Site currently extant, historic at time recovery plan completed (USFWS 1991)

FL = Fassett's locoweed

SNA = State Natural Area

USFS = U.S. Forest Service

APPENDIX C

Fassett's Locoweed Survey Protocol

To help maintain a consistent record of Fassett's locoweed population information, continued collection of the following basic survey information is recommended.

Basic survey information:

1. Plant categories: The following three categories of Fassett's locoweed plants should be surveyed at each site (refer to photo below):

Seedlings: Plants that germinate in the current year, possessing either cotyledons (seed leaves), leaves with 3 leaflets, or both.

Non-reproductive plants: Plants with greater than 3 leaflets on all leaves, and no racemes (flowering stems) in the current year.

Reproductive plants: Plants with greater than 3 leaflets on all leaves, and racemes (flowering stems) in the current year.

Use of the above categories is consistent with studies conducted by Feldman (2009-2012) and Almasi (2006, 2007) at Plainfield and Pickerel lakes. The WDNR and the USFS plan to use these categories when surveying for the species.

Note: Flowering Fassett's locoweed adult plants can revert to non-flowering adult plants in future years and sometimes very old adult plants do not bloom in a given year. Some of the older adults can also look smaller than they were in past years, therefore plant categories do not equate with plant age. In addition non-reproductive plants grow into small or large reproductive plants (Tracy Feldman, UW-SP, pers. comm., 2012). Recording plant size (diameter across the rosette) is an additional way of characterizing plants (Feldman 2010), but including size as a sampling parameter is much more time consuming and therefore not recommended as a standard survey protocol.

2. Population count: The numbers of plants in each of the three categories should be recorded and summed for the population count. If numbers of plants are too great to easily count directly, use random samples stratified at different distances from the water line to estimate the population number (see Almasi 2007, Feldman 2009, 2010, 2011, 2012).
3. Threats: Record and monitor threats to Fassett's locoweed or its habitat at each site e.g., invasive species, human impacts (ATV, foot traffic, etc.), and herbivory (insect and mammal) (refer to section 2.3.2 above). Inform land managers of threats and provide recommendations to address the threats.

Other parameters that could be measured:

Collecting the following information would further the understanding of the population dynamics of Fassett's locoweed.

Plant seed production:

The number of seeds produced per fruit could be used to estimate seeds produced per plant. Feldman (2008, 2009) estimated seeds produced per fruit and counted the numbers of fruits produced by tagged plants on Plainfield and Pickerel lakes (Feldman 2009, 2010, 2011, 2012). These numbers could be used to estimate seeds produced per plant (seeds produced per fruit multiplied by fruits produced per plant).

Seeds in the soil bank

Seeds in the soil (seed banks) can be monitored with soil cores or surface counts (using a random sample design).

Distinguishing between individual Fassett's locoweed plants:

Fassett's locoweed plants do not appear to have extensive runners to produce multiple ramets (stems) from the same genet (individual), so isolated Fassett's locoweed rosettes are likely individual plants. However, locoweed plants may grow in dense patches as well, and individual plants in these patches can be difficult to distinguish. Moreover plants may produce localized rhizomes associated with the same taproot, from which more stems and racemes may grow. These rhizomes may be buried, so they are often not readily apparent. In dense patches, Feldman (2009, 2010, 2011, 2012) counted Fassett's locoweed stems as being from the same individual if all of the stems in a given "clump" seem to come from the same central area (i.e., if the stems are oriented outward from that central area where they emerge from the ground) (refer to Figure C1 and photos below).

In sparse patches, it is probably safe to assume that each rosette belongs to a separate individual plant. Thus, all rosettes can be counted directly. To know for sure whether nearby plants are separate individuals, genetic studies would likely be needed.

Small, younger plants may be challenging to distinguish as separate individuals, as young plants may establish at high densities. Older plants may also be challenging to separate into individuals because some older plants may partially die, maintaining several living stems that may be separated by more than 10 cm (3.9 inches) (but usually less), each stem being associated with a few leaves. Often in older Fassett's locoweed plants, the dead stems of the old plant are present close to the ground, connecting living stems. As these older stems may degenerate or become buried, it is important to look carefully for these stems. Also, in older plants, the living stems are often wider and larger than younger stems with the equivalent amount of vegetation (Feldman, pers. obs., 2009-2012) (refer to photo below).

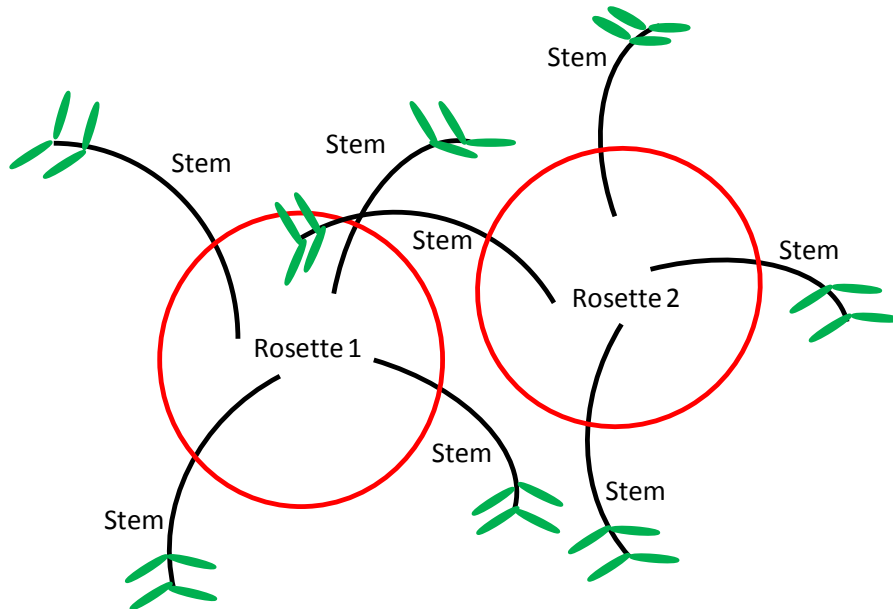
Feldman (2009-2011), in constructing his projection matrix model, used size (diameter across the rosette) to categorize plants (rather than flowering status) because size was more highly correlated with changes in the plants' reproduction, survival, and growth than other ways of categorizing plants. Feldman cautions that the three plant categories noted above are general categories and should not be used to represent plant age, except for the seedling category (Feldman, UW-SP, pers. comm., 2012).

One seedling, one non-reproductive, and one reproductive Fassett's locoweed plant.



Photos courtesy of Tracy S. Feldman, UW-SP.

Figure C1. Distinguishing among individual Fassett's locoweed plants.



One Fassett's locoweed plant is identified as a clump of stems that come from the same central area with the stems oriented outward from that elliptical area. Black lines denote Fassett's locoweed stems, which may have several leaves and at least one raceme (flowering stem). The red circles denote rosettes, used as the boundaries between individual locoweed plants. These plants are separate because their stems originate from a different rosette.

Distinguishing among individual Fassett's locoweed plants: field example showing stems associated with three Fassett's locoweed plants.



One Fassett's locoweed plant is identified as a clump of stems that come from the same central area with the stems oriented outward from that elliptical area. The red circles denote rosettes, used as the boundaries between individual locoweed plants. These "plants" are separate because their stems originate from a different rosette.

Single Fassett's locoweed plant with rhizomes separating stems.



Note: The white arrow indicates a rhizome. Photo courtesy of Tracy S. Feldman.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW
of
Fassett's Locoweed

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

Downlist to Threatened
 Uplist to Endangered
 Delist
 No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable:
NA (no change, remains 9)

Review Conducted By: Cathy Carnes

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve *1. [Signature]* Date *14 June 2013*

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Fish and Wildlife Service

Approve *Lynn M Lewis* Date *6/19/13*