

Hackelia venusta
(Showy Stickseed)

**5-Year Review
Summary and Evaluation**



**U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington**

September 30, 2011

5-YEAR REVIEW

Species reviewed: *Hackelia venusta* (Showy Stickseed)

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5-YEAR REVIEW

Showy stickseed (*Hackelia venusta*)

1.0 GENERAL INFORMATION

1.1 Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (ESA or Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing as endangered or threatened is based on the species' status considering the five threat factors described in section 4(a)(1) of the Act. These same five factors are considered in any subsequent reclassification or delisting decision. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process including public review and comment.

1.2 Reviewers

Lead Regional Office: Pacific Region: Sarah Hall, Acting Endangered Species Recovery Coordinator, (503) 231-6868.

Lead Field Office: Spokane, WA, Ecological Services, Eastern Washington Field Office: Carrie Cordova, Fish and Wildlife Biologist, (509) 893-8022.

Cooperating Field Office(s): Wenatchee, WA, Ecological Services, Central Washington Field Office: Timothy McCracken (509) 665-3508.

1.3 Methodology used to complete the review: In conducting this 5-year review, we relied on available information pertaining to historic and current distributions, life history, and habitat of this species. Our sources include the final rule listing this species under the Act; the recovery plan; peer reviewed scientific publications; unpublished field observations by the Service, State, and other experienced biologists; unpublished survey reports; and notes and communications from other qualified biologists. The public notice for this review was published on November 24, 2010, with a 60-day public comment period. We received two comments.

1.4 Background:

1.4.1 FR Notice citation announcing initiation of this review:

1.4.2 Listing history

Original Listing

FR notice: 67 FR 5515

Date listed: Final Rule February 6, 2002

Entity listed: Species

Classification: Endangered

1.4.3 Associated rulemakings:

Critical habitat was not considered prudent at the time of listing. There is no other rulemaking associated with this species.

1.4.4 Review History:

This is the first 5-year review for this species. The Service's final listing rule was published on February 6, 2002 (67 FR 5515). Public availability of the draft *Hackelia venusta* Recovery Plan was published in 2006 (71 FR 12711). Public availability of the final *Hackelia venusta* Recovery Plan was published in 2007 (72 FR 70602).

Final Recovery Plan – 2007

1.4.5 Species' Recovery Priority Number at start of this 5-year review:

At the start of the 5-year review, the Recovery Priority Number for the *Hackelia venusta* was 5, signifying its status as a full species with a high degree of threat and a low recovery potential.

1.4.6 Current Recovery Plan or Outline

Name of plan or outline: Recovery Plan for *Hackelia venusta* (Showy stickseed)

Date issued: October 10, 2007

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. Because the species under review is a plant and the DPS policy is not applicable, the DPS policy is not addressed further in this review.

2.2 Recovery Criteria

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

Yes
 No

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
 No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery plan?

Yes
 No

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 team grouped the recovery criteria under the five listing factors. They are discussed below. The listing factors are discussed in more detail in section 2.3.2.

Recovery Criteria associated with Factor A: Present or threatened destruction, modification or curtailment of its habitat or range.

In order to ensure the long-term recovery needs of *H. venusta*, threats to the species habitat must be reduced or removed. This will be accomplished if the following have occurred (USFWS 2007):

- a. Tree and shrub cover in all populations is maintained at a level equal to or more open than that present in 2007 in the original population, through manual removal or controlled (prescribed) burns.
- b. Noxious weed populations are not present within any populations or close enough to them to pose a significant threat of invasion, or are annually removed.
- c. Herbicide and road de-icer use continues to be minimized or avoided, within all populations or close proximity to individual plants.
- d. All population sites have been evaluated for landslide or mass wasting potential. If funding becomes available a plan will be developed and implemented to minimize the effects of landslides on *H. venusta* populations.

The threats identified at listing from present or threatened destruction, modification or curtailment of its habitat or range still threaten *H. venusta*. The current threats include fire

suppression, potential threats from invasive, non-native herbicide and road de-icer use along the main highway and landslides. The U.S. Forest Service (FS) has the primary responsibility for management and conservation of this plant as the core population occurs on FS lands. Many criteria are being met, including hand-pulling of weeds by the FS, implementation of a Tumwater Canyon plant management plan by Washington Department of Transportation (WDOT), and efforts to stabilize the slope where the population occurs. See additional discussion under section 2.3.2.1.

Recovery Criteria associated with Factor B: Overutilization for commercial, scientific, or educational purposes.

In order to ensure the long-term recovery needs of *H. venusta*, threats to the species through collecting and visitation must be reduced or removed. This will have been accomplished if the following have occurred (USFWS 2007):

- a. Seed collection guidelines finalized within three years of publishing this plan.
- b. A guideline of not sharing specific site location information with the public or the press is accepted by the U.S. Forest Service.
- c. The pullout across the highway from the population has been modified or removed to discourage the public from stopping their vehicles and crossing the highway.
- d. The U.S. Forest Service has an entry log in place, and all permitted entries into the population are logged.
- e. All research within the population is approved by the U.S. Fish and Wildlife Service and the U.S. Forest Service after review by the recovery team.

The threats identified in the recovery plan from overutilization for commercial, scientific, or educational purposes have been minimized with numerous efforts including development of seed collection guidelines, not sharing location information, modifying the highway pullout, implementing the use of an entry log, and research review and approval steps. The FS has been implementing the use of an entry log, however, this requirement is difficult to enforce and more consistency is required for this criteria to be met. See further discussion under section 2.3.2.2.

Recovery Criteria associated with Factor C: Disease or predation.

In order to ensure the long-term recovery needs of *H. venusta*, threats to the species through predation by the biocontrol agent must be reduced or removed. This will have been accomplished if the following have occurred (USFWS 2007):

- a. A monitoring program is in place to inspect *H. venusta* and populations of *Cynoglossum officinale* (gypsyflower) have been identified in Chelan County on an annual basis for the presence of the biocontrol agent, *Mogulones cruciger*.
- b. A written plan is in place for actions to undertake if the weevil is found and determined to have negative effects on *H. venusta*.

Currently threats to *H. venusta* from disease or predation are not known to occur. These recovery criteria will need to be addressed if new information becomes available regarding the

presence of *Mogulones cruciger* in the *H. venusta* population. A detailed monitoring plan for presence/absence of the weevil in the population is needed to aid the FS in determining if the weevil is present and to aid in determining how it is affecting *H. venusta* plants. See further discussion under section 2.3.2.3.

Recovery Criteria associated with Factor D: Inadequacy of existing regulatory mechanisms.

In order to ensure the long-term recovery needs of *H. venusta*, regulatory mechanisms need to be strengthened. This will have been accomplished if the following have occurred (USFWS 2007):

- a. Habitat management plans have been developed and implemented by the U.S. Forest Service. Management plans will include provisions, as appropriate, for habitat maintenance and restoration, noxious weed control, fire management, recreational activities, and monitoring and research.
- b. A revised management plan has been developed and implemented by the Washington Department of Transportation. The management plan will include provisions, as appropriate, for habitat maintenance and restoration, noxious weed control, and highway maintenance activities.
- c. All *H. venusta* populations on public lands are within management areas where maintenance of the species is a primary management goal.

The inadequacy of existing regulatory mechanisms has not entirely been addressed for recovery of *H. venusta*. A management plan has been developed by WDOT and implemented, while the habitat management plan for the Okanogan/Wenatchee National Forest is still being developed. It is important to have this management tool to guide FS actions regarding the plant. The Service has addressed certain projects that have resulted in impacts to *H. venusta* through section 7 consultations with the U.S. Forest Service. See discussion under section 2.3.2.4.

Recovery Criteria associated with Factor E: Other natural or manmade factors affecting its continued existence.

In order to ensure the long-term recovery needs of *H. venusta*, there must be more populations that are stable and self-sustaining. The genetic resources of the species must also be adequately protected through seed collection and storage, in case of catastrophic events in Tumwater Canyon. This will be accomplished if the following have occurred (USFWS 2007):

- a. At least three stable, self-sustaining populations are present within Tumwater Canyon on protected sites (owned or managed by a government agency or private conservation organization that identifies conservation and management of *H. venusta* as the primary management objective for the site), separated by at least 2 kilometers (1.2 miles) or by the Wenatchee River. These could be the result of identification through further inventory, or through reintroduction or augmentation. If a new population is discovered outside of Tumwater Canyon, it may contribute to meeting this criterion. To be deemed stable and self-sustaining, a population must maintain a 5-year average of at least 1,000 adult plants, must show evidence of positive or neutral population growth over the same

5-year period, and must show evidence of establishment from natural reproduction and survival.

b. Genetic material, in the form of seeds adequately representing the geographic distribution and genetic diversity within the species, is collected and stored in at least one facility approved by the Center for Plant Conservation.

These recovery criteria have not been met, as there is only one population and there is still much research needed with respect to these criteria. Research is ongoing at University of Idaho and Western Washington University, although results are inconclusive at this time. Seed collection continues with seeds stored at the Miller Seed Vault at University of Washington for use as research, restoration and reintroduction needs require. See discussion under sections 2.3.1.3 and 2.3.2.5.

2.2.3.6 Monitoring Criteria.

The recovery plan also included criteria for ongoing monitoring (USFWS 2007). The recovery plan expected that in order to ensure the efficacy of recovery actions and allow for adaptive management, as necessary, population and habitat monitoring will have been established for all populations of the taxon at appropriate intervals. Habitat monitoring should include a plant census, monitoring of shrub and tree cover, and inventory of nonnative species. Monitoring must be planned and conducted to minimize the potential negative impacts on the species and its habitat. There must be written agreements to continue monitoring after downlisting.

Monitoring has occurred, and this criterion is currently being met. The Washington Natural Heritage Program (WNHP) is the main entity involved with monitoring efforts for *H. venusta*. Population monitoring has occurred somewhat irregularly. Annual inventories continue of the *H. venusta* population and potential reintroduction sites for the plant. Because the taxonomy of *H. venusta* and *H. "taylori"* remains unresolved, the high elevation populations were included in WNHP inventory efforts. The most up-to-date WNHP population summaries are in section 2.3.1.2.

2.3 Updated Information and Current Species Status. Please refer to Final Recovery Plan for additional information and status (USFWS 2007).

2.3.1 Biology and Habitat

H. venusta is a short, moderately stout species, 20 to 40 centimeters (8 to 16 inches) tall, often with numerous, erect to ascending stems from a slender taproot. It has large, showy, five-lobed flowers that are white or white washed with blue, and are approximately 1.9 to 2.2 centimeters (0.75 to 0.87 inch) across when measured from above from tip of petal to tip of petal. The fornications (appendages at the base of each petal) are showy, truncate or very slightly marginated, but not papillate. The basal leaves are 7 to 14 centimeters (2.8 to 5.5 inches) long and 0.64 to 1.3 centimeters (0.25 to 0.5 inches) wide, while the upper stem leaves are 2.5 to 5.1 centimeters (1 to 2 inches) long and 0.38 to 0.64 centimeters (0.15 to 0.25 inches) wide (Barrett *et al.* 1985). The leaves have a fringe of marginal hairs. The fruit consists of four prickly nutlets per flower, approximately 0.38 to 0.43 centimeters (0.15 to 0.17 inches) long. The marginal prickles are

united for up to one-half of their length, forming a flange around the nutlet (Gentry and Carr 1976).

H. venusta is restricted to one small population scattered over approximately 16 hectares (40 acres) of unstable, granitic sand and granite cliffs on the middle and lower slopes of Tumwater Canyon, Chelan County, Washington. Clusters of plants are concentrated in open, unstable areas of granitic sand and talus, and on ledges and cracks of vertical granite cliffs. The feature common to the variety of habitats where the species is found is the relatively sparse cover of other vascular plants and low canopy cover. The species appears to be dependent upon the maintenance of open habitat (USFWS 2007).

Soils at the Tumwater Canyon population are described by Gamon et al. (1997) as “loamy sand or sandy loam with 0 to 40 percent gravel . . . derived from granitic and gneissic rocks” on a slope of 25 to 70 degrees. In 2008, Jeanie Taylor studied the reproductive biology of *H. venusta*. The plants she studied also grew on steeper slopes, and those in rock crevices up to 90 degrees were among the largest she worked with. Plants at higher elevations in the population can be seen growing in inaccessible cliff tops or cliff faces; large plants also grow among grass, and under the shade of large conifers. The texture of the surface soil ranges from sand to coarse gravelly sand that is easily eroded, especially when the soil dries out during the summer. The site as a whole is so steep that loose material or objects on almost any part of the site readily roll downhill. Cliffs provide protected sites for plants, but are also the source for loose slabs of rock and boulders that are constantly sliding downhill and threatening established plants (Taylor 2008).

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

In 2008, Jeanie Taylor studied *H. venusta* to understand pollination biology of the plant and answer basic questions as to whether it is self-pollinizing or outcrossing. Results from field tests indicate that this species is predominantly outcrossing, relying on insects to deliver pollen most of the time. The amount of insect-mediated selfing has yet to be determined, however, the role of small and large insects in pollination is discussed further in Taylor 2008. Taylor (2008) found that pollinators observed on and in *H. venusta* flowers are not rare, or specialists on this plant. *H. venusta* morphology fits the needs of thrips (Order Thysanoptera) and other small insects very well. The larvae can rear inside the corolla, well protected in a warm, moist environment with a ready supply of nectar to feed on; and many were found in this living arrangement when hand pollinating plants. Although thrips and other small insects may not be major pollinators, based on their abundance in the first year of the study, and the fact that they were not damaging the plants, Taylor (2008) concluded that they could be secondary pollinators.

A 2007 study (WNHP) was conducted to identify sites where new populations of *H. venusta* could be established and previous attempts at establishing new populations also provided useful information. In 2010, two plants were still alive at the Icicle Canyon introduction site in the Wenatchee National Forest. One appeared to be a seedling, approximately four inches from the other, and one plant had mature, apparently viable, seed. While the previous outplanting efforts have nearly or entirely failed, they have yielded information on potential site requirements, and

the relative success under different conditions has provided information on site suitability. This project has attempted to utilize all available information, including environmental characteristics and geologic substrate, to identify sites in the region that might serve as outplanting sites (WNHP 2011). So far, no other sites in the Wenatchee Mountains were found that were very similar to the extant *H. venusta* site. The steep unstable soil, formed from decomposing granite, appears to be uncommon in the region, and the study was unsuccessful in finding other areas with similar substrate and vegetation. Therefore, efforts are being focused on better understanding the conditions under which the species is growing and to establish a method to more closely monitor the changes in the extant population (WNHP 2011).

In 2011, a proposal was funded with FWS Recovery funding to study shrub encroachment and outplantings for *H. venusta*. Project work will not begin until the spring of 2012. The information from this study will help improve our understanding of *H. venusta* and its habitat characteristics and management of the species.

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:

In 2004, the entire population was censused, including the core and outlying plants, for a total of 572-772 individuals, or, an estimate of approximately 700 individuals for the total population. The careful counts of the core population (a subpopulation of what was censused in 2004) completed in 2009 and 2010 give an average of around 200. It appears the population numbers are declining (Table 1). However, the recovery team discussed the need for a standard, consistent protocol for monitoring *H. venusta* at the September 21, 2011, meeting and without this protocol the trend of the population remains unclear (L. Malmquist, pers. comm. 2011). While these numbers are imprecise, we can use them to estimate a population range for *H. venusta*, from about 140 plants to more than 700 during the period of monitoring, regardless of survey acreage. These numbers provide the best available view of the size of the global extent of *H. venusta* through the years in which it has been monitored (WNHP 2011).

Table 1. Summary of *Hackelia venusta* population estimates, 1968-2011 (WNHP 2011)

Year	Population size	Notes on estimate, including source
1968	common	Field observations by J. Carr: Common on south facing slope. Appears limited to a few hundred acres in the (Tumwater) canyon proper. Gentry and Carr (1976)
1978	occasional	Field monitoring by D. Varney (WNHP 2011): Occasional in very localized area.
1981	ca. 1000 plants	Estimate by Reid Schuller, May 1, 1981
1984	396	Field count by Jim Barrett, June 11, 1984
1987	385 in 12 acres	Reported in Gamon (1997)
1995	About 140 plants in 2.5 acres	Reported in Gamon (1997). Recovery plan describes census by Ted Thomas, Richie Harrod, Paul Wagner
1997	About 140	About 140 individuals over approximately 12 acres. "The number of individuals at this site has decreased to approximately 130-140 individuals in recent years." Ted Thomas, USFWS, pers. comm. 1997 (Gamon 1997).
2000	Nearly 300 plants over 10 acres	Described in Recovery Plan, pers comm. from Lauri Malmquist
2001	Nearly 500 plants in 10 acres	Malmquist 2001 pers comm.
2004	572-772	WNHP census, counting outliers and estimating the core population
2009	282	WNHP census, estimating outliers (based on previous years count) and counting the core population
2010	316	WNHP census, estimating outliers (based on previous years count) and counting the core population
2011	283	WNHP census of outliers and estimating core population

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

Our understanding of *H. venusta* is complicated by a lack of taxonomic clarity about the relationship between plants in Tumwater Canyon with exceptionally large white flowers and high elevation blue-flowering plants known from Icicle Ridge and the Enchantments areas of the Wenatchee National Forest. When Gentry and Carr (1976) wrote the monograph on this genus, they were only aware of a single collection of the high elevation plants, and they considered them to be conspecific with *H. venusta*. However, in the years since the work by Gentry and Carr, three more populations have been discovered, and many botanists have come to regard the high elevation plants as a distinct taxon. These plants were explicitly excluded from the federal listing of *H. venusta* as endangered under the Endangered Species Act (USFWS 2002). A paper was drafted several years ago (Harrod et al. no date) to describe the high elevation plants as *H. taylori*, but so far the paper has not been published. This places the botanical community in the awkward position of not having an appropriate name for these high elevation plants and of not understanding the genetic relationships among two groups of very rare plants warranting high conservation priority. For simplicity in this report, to be explicit about which group of plants we are referring to, and to express that this is not yet a published name, we will refer to the high

elevation plants as *Hackelia* “*taylori*,” and the white-flowered Tumwater Canyon plants, listed under the Endangered Species Act as endangered, as *H. venusta* (WNHP 2011).

Genetic analysis of both species has been conducted at the University of Washington to determine what level of taxonomic separation between *H. venusta* and *H. “taylorii”*, if any, is required (Sarah Reichard, Professor of Botany, University of Washington, pers. comm. 2007). However, this project was unable to develop correct and useable genetic markers that could be used to distinguish between the two entities.

Genetic analysis efforts were then conducted in 2010 and 2011, at Western Washington University. Barry Wendling and his advisor, Eric DeChaine, extracted DNA from numerous species in the Borage Family (including *H. venusta* and the high elevation blue-flowered *Hackelia* that we refer to as Taylor’s stickseed) and sequenced four genetic regions, three chloroplast and one nuclear. The species they studied included most Washington *Hackelias*, a few from other areas, and outliers in two other genera in Boraginaceae. They have prepared a draft paper, which is not yet available, and so their results are preliminary. In general, their analyses of the chloroplast regions that they sequenced place *H. venusta* and Taylor’s stickseed in a single well-delineated group, but fail to distinguish between the two forms. Their analyses of the nuclear region that they sequenced also failed to distinguish between the two forms, and suggested that the current taxonomy of *H. venusta*, based on Gentry and Carr (1976), does not in all cases correspond well with the pattern of gene sequences that they identified (Arnett pers. comm. 2011). Future studies to better resolve the cryptic relationship between populations of the blue and white forms of *H. Venusta* and their relationship to other north American taxa are necessary and should incorporate a combination of additional species, individuals, and molecular analyses, including additional markers and methods, such as AFLP, microsatellite, or anonymous loci techniques (Wendling, unpublished).

As an additional record of work with this species, maps of areas that have been inventoried specifically for *H. venusta*, including the high elevation blue-flowered plants referred to as Taylor’s stickseed have been included in studies of the plant. These plants were included in Gentry and Carr’s (1976) delineation of *H. venusta*, though the federal listing of the species (USFWS 2002) explicitly excludes them. To date, although there is a paper in draft to describe them as a separate species (Harrod et al. 2007), and ongoing research is underway to determine their appropriate taxonomic status (Wendling and DeChaine 2011), the only published nomenclature available includes them in *H. venusta*, with no intraspecific classification described (WNHP 2011).

2.3.1.4 Taxonomic classification or changes in nomenclature:

The taxonomy of these plants remains unresolved; it is possible that the blue-flowered form may best be interpreted as occurring within the natural variability of *H. venusta*. However, the habitats where the taxa occur are sharply distinct, and no intermediates in habitat or morphology have been found. If more thorough analysis supports the inclusion of the high elevation plants within *H. venusta*, the exclusion of these plants in the federal listing will need to be revisited, and they will need to be considered in conservation planning for the species (WNHP 2011). Until these issues are resolved, we consider *H. venusta* to be a separate species.

The Integrated Taxonomic Information System (ITIS 2009) was checked while conducting this review and no taxonomic changes have been recorded there (ITIS 2009).

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.):

Historically, the specimen for *H. venusta* was collected in 1920 at a site between Tumwater and Drury in Tumwater Canyon, west of Leavenworth, Washington. *H. venusta* has never been found other than within this single population in Tumwater Canyon. During the late 1990s, and since the publication of the proposed rule to list the species on February 14, 2000 (USFWS 2000), the population of *H. venusta* has been monitored somewhat irregularly. Annual monitoring may be hampered by extreme slope instability and result in damage to plants and seedlings. In May 2000, nearly 300 plants were counted over 4 hectares (10 acres), and in May 2001, the number of plants in the population approached 500 plants over 4 hectares (10 acres) (L. Malmquist, *in litt.* 2000, pers comm. 2001). See monitoring discussion above for current monitoring data.

The known distribution of *H. venusta* plants may not be complete, as few records remain that document where botanists have looked for *H. venusta* specifically. Forest Service records of negative rare plant surveys have inadvertently been lost, and the only such information that can presently be found in the Washington Natural Heritage Program files are maps of surveys made by Jim Barrett, a botanist working in the area in 1984 (WNHP 2007; J. Barrett, *in litt.* 1984). Maps compiled of these surveys and the 2004 surveys referenced above are available in WNHP 2007.

From a demographic perspective the total population is still extremely small. The population is still smaller in area and/or numbers of individuals than the estimates made in 1968 or in 1981, but appears to have increased from the very low numbers of the mid-1990s.

Based on the life history characteristics of *H. venusta* (a perennial that occupies an unstable habitat) and the observed variability in the numbers of individuals present in the one known population over the years, a population that maintains at least 1,000 flowering plants is presumed by the recovery team to be minimally viable for this taxon. Population viability analysis has not been undertaken for *H. venusta*. Minimum viable population size is affected by many factors, including life history of the species and the degree of stochasticity (unpredictability) of the environment (Shaffer 1987). Effective population sizes as small as 500 plants have allowed the maintenance of genetic heterogeneity for some species (Barrett and Kohn 1991). For species that occupy habitats with high levels of environmental uncertainty, the estimated minimum size for viability is estimated to be more on the order of at least 1,000 individuals (Nunney and Campbell 1993). Plants are especially vulnerable to disturbance events due to their sessile nature (Menges 1991), and particularly in cases such as this when there are few populations of the species left, there is little room for variance in setting the minimum number of individuals needed (Shaffer and Samson 1985). Given the highly unpredictable nature of the environment of

H. venusta, its extreme vulnerability to stochastic events, and observed past levels of variability in numbers of individuals in the population, the recovery team felt that a population of *H. venusta* would likely not be viable without at least 1,000 plants (USFWS 2007, p. 8).

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

The available habitat and prevailing land uses remain essentially the same as they were at the time of listing.

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:

The threats identified at the time of listing (2002) still threaten *H. venusta*. The current threats include fire suppression, potential threats from invasives, herbicide and road de-icer use along the main highway, and landslides. The U.S. Forest Service (FS) has the primary responsibility for the management and conservation of this plant as the core population occurs on FS lands. Activities conducted by the FS for this species are described in the following paragraphs.

There has not been any manual removal of tree and shrub cover in the current *H. venusta* population, or controlled burns on the site (L. Malmquist, pers. comm. 2011). Under an agreement with the Washington Department of Transportation, U.S. Forest Service staff currently hand-pull invasive species along the right-of-way within 0.8 kilometer (0.5 mile) of the known population. This agreement emphasizes treatment to the habitat directly adjacent to the State highway where invasive species tend to become established and then spread into the remainder of the population (USFWS 2010). The ridgetop on the eastern edge of the population is infested with *Linaria dalmatica* (Dalmation toadflax) but not to a degree that threatens the population (L. Malmquist, 2011). In addition, there has not been an evaluation completed by the FS for mass wasting potential or plans developed and implemented to minimize the effects of landslides on *H. venusta*.

The WDOT is aware of the potential threat from road maintenance and management to *H. venusta*, and is actively cooperating with the U.S. Fish and Wildlife Service, U.S. Forest Service, and the Washington Department of Natural Resources. *The Management Plan for Rare Plant Species in Tumwater Canyon, Wenatchee National Forest with Associated Best Management Practices* (WDOT 2000), provides guidance to plan and manage their maintenance activities so as to minimize impacts on the rare plant species of Tumwater Canyon (WDOT 2000); however, this plan currently needs to be revised.

In 2011, the Federal Highway Administration (FHWA) conducted a slope stabilization project at two locations adjacent to U.S. 2 between Mile Post (MP) 91.20 to 91.50 and between MP 94.20 to 94.40, within Tumwater Canyon in Chelan County, Washington. This area includes the area where *H. venusta* is currently located. Trees and shrubs were removed to allow for better habitat

conditions for the survival of *H. venusta*. This action is consistent with recovery actions outlined in the recovery plan. Removing the excess material from the slope is expected to prevent or minimize the opportunities for mass wasting events on the slope, and removal of large rock will prevent the plants from being crushed by rolling boulders. WDOT, in consultation with the Service, has covered part of the lower slope with modified cable netting where plants may be easily accessed for seed or plant collection by interested parties. This action is expected to ensure more plants remain protected from overutilization. It is uncertain how these activities will affect *H. venusta* at this point in time. One *H. venusta* plant was found damaged from project activities and salvaged by the FS botanist; however, this plant did not survive. Seeds were collected from this plant and sent to the University of Washington Miller Seed Vault (L. Malmquist, pers. comm. 2011).

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

The threats identified in the recovery plan have been minimized with numerous efforts. The *H. venusta* recovery team has addressed the issue of seed collection guidelines and the 2004 guidelines (Caplow 2004) were finalized and modified by Joe Arnett in 2007 (WNHP 2007). These will continue to be edited and modified as new information becomes available. The FS adheres to the guideline of not sharing specific site location information for *H. venusta* with the public or the press. They have also modified the pullout across the road from the *H. venusta* population by moving it away from its previous location directly across from the main population to a site farther down the main highway. The FS has also been using an entry log to control entries into the population; however, this requirement is difficult to enforce and the Forest Service will need to be more consistent in its implementation. In addition, any and all research that is conducted within the population requires review and approval by the U.S. Fish and Wildlife Service and the FS after the *H. venusta* recovery team has reviewed and approved the proposals.

2.3.2.3 Disease or predation:

Disease or predation are not currently threats to *H. venusta*. The presence of the houndstongue root weevil, *Mogulones cruciger*, a borage-specific biocontrol weevil, has not been documented within the *H. venusta* population; however, the FS has expressed a need for a formal monitoring plan for the presence/absence of this weevil in the population. Discussions occurred regarding this monitoring plan during the September 21, 2011, recovery team meeting; however, no final determination was made (L. Malmquist, pers. comm. 2011). In 2009, the USDA APHIS came out with a position statement on the *Mogulones cruciger* determining this weevil to be a pest and discouraging any person from deliberately moving this weevil into and around Washington state (Reichard pers. comm. 2009). The FS botanist is currently in contact with other botanists and bio-control agents on the status of *Cynoglossum officinale* (gypsyflower) and use of the *Mogulones cruciger* biocontrol. The weevil has been documented in Okanogan county. Collected seeds were sent to University of Idaho for houndstongue biocontrol research. This research will work to answer the question whether any native confamilial species of the exotic *Cynoglossum officinale* L. (gypsyflower) are at risk to nontarget feeding by the weevil (*Mogulones cruciger*). These results will help to understand the relationships between the weevil and the gypsyflower, with a further goal to understand the potential effects to *H. venusta*

populations (W. Gibble, pers. comm. 2011). There currently is no written plan in place for actions to be undertaken if the weevil is found within the *H. venusta* population and determined to have negative effects on the population (L. Malmquist, pers. comm. 2011).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Although most of the known population of *H. venusta* is located in an area designated as a special management area by the FS, the species remains vulnerable to threats. The Wenatchee National Forest continues to maintain the Tumwater Canyon Botanical Area designation and has implemented special management practices specifically targeted to conserve rare species, including *H. venusta* (USFWS 2002).

Since listing, the following mechanisms apply to *H. venusta*.

The WDNR designated *H. venusta* as State endangered in 1981 (WNHP 1981), and this designation has been retained in subsequent updates of the State's endangered species list. However, this designation provides no regulatory protection for the plant (www.dnr.wa.gov/nhp/refdesk/lists/plant_changes.html).

National Environmental Policy Act (NEPA): NEPA (42 U.S.C. 4371 *et seq.*) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of such projects with a Federal nexus, NEPA requires the Federal agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.14(f)). These mitigations can provide some level of protection for listed species. However, NEPA does not require that environmental impacts be avoided, only that effects be assessed and the analysis disclosed to the public.

Endangered Species Act of 1973, as amended (Act): Since listing, the Act is the primary Federal law that may provide protection for this species. The Service's responsibilities include administering the Act, including sections 7, 9, and 10. Section 7(a)(2) of the Act requires Federal agencies, including the Service, to ensure that actions they fund, authorize, or carry out do not "jeopardize" a listed species or result in the "destruction or adverse modification" of habitat in areas designated by the Service to be "critical". A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 C.F.R. § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project.

Under Section 9(a)(2) of the Act, with respect to endangered plant taxa, it is unlawful to remove and reduce to possession (i.e., collect) any such taxon from areas under Federal jurisdiction; maliciously damage or destroy any such taxon on any such area; or remove, cut, dig up, or damage or destroy such species on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

The Service has addressed certain projects that have resulted in impacts to *H. venusta* through section 7 consultations with the Federal Highways Administration (FHWA). In 2011, a non-jeopardy biological opinion was issued addressing the effects of the 2011 WDOT slope stabilization project occurring on the slope where *H. venusta* currently occurs. The primary activities associated with the project included removal of trees and shrubs and other excess material from the slope, consistent with recovery actions outlined in the recovery plan, along with placement of modified cable netting, to improve safety along Highway 2. The project has been completed and effects to *H. venusta* plants were much lower than originally anticipated through the consultation process.

In summary, these threats still occur. The Washington Natural Heritage Program, in coordination with the Wenatchee National Forest, developed management guidelines for *H. venusta* in 1988 (Gamon 1988b). These guidelines contain recommendations that specific actions be taken to protect the plant on National Forest land, and the FS continues to implement these recommendations; however, they have not been updated since their development in 1988. These guidelines also included the recommendation that the Wenatchee National Forest develop a species management guide to provide management direction for the habitat of this species. The Wenatchee National Forest developed a draft management guide several years ago, but it has not been finalized (T. Lillybridge, pers. comm. 1997; T. Thomas, *in litt.* 2005. L. Malmquist, pers. comm. 2011). Meanwhile, all *H. venusta* populations on public lands are within management areas where maintenance of the species is a primary management goal. The FS continues to prohibit the collection of native plants without a permit, although this regulation has been difficult to enforce (R. Harrod, pers. comm. 1998, L. Malmquist, pers. comm. 2011).

WDOT will continue to implement the *Management Plan for Rare Plant Species in Tumwater Canyon, Wenatchee National Forest*, (WDOT 2000) to address the risk posed by noxious weeds within *H. venusta* habitat and provide BMPs for road crews while conducting maintenance activities along the stretch of the highway in Tumwater Canyon occupied by the *H. venusta*. This plan was completed with U.S. Fish and Wildlife Service, FS, and WNHP; however funding for implementation of this plan is dependent upon congressional and state legislatures and as such cannot be assured on an annual basis.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Low Seed Production. Low seed production is a factor in the decline of *H. venusta*. The small size of the only known population of *H. venusta* is a major problem for recovery. The small number of individuals remaining in the sole population located in Tumwater Canyon makes *H. venusta* vulnerable to extinction due to random events. A single random environmental event could extirpate a substantial portion or all of the remaining individuals of this species, leading to extinction. Also, changes in gene frequencies within small, isolated populations can lead to a loss of genetic variability and a reduced likelihood of long-term viability (Franklin 1980; Soulé 1980; Lande and Barrowclough 1987; R. Carr, *in litt.* 2000).

Climate Change. Changes in climate can have a variety of direct and indirect impacts on species, and can exacerbate the effects of other threats. Rather than assessing “climate change” as a

single threat in and of itself, we examine the potential consequences to species and their habitats that arise from changes in environmental conditions associated with various aspects of climate change. For example, climate-related changes to habitats, predator-prey relationships, disease and disease vectors, or conditions that exceed the physiological tolerances of a species, occurring individually or in combination, may affect the status of a species. Vulnerability to climate change impacts is a function of sensitivity to those changes, exposure to those changes, and adaptive capacity (IPCC 2007, p. 89; Glick *et al.* 2011, pp. 19-22). As described above, in evaluating the status of a species, the Service uses the best scientific and commercial data available, and this includes consideration of direct and indirect effects of climate change. As is the case with all potential threats, if a species is currently affected or is expected to be affected by one or more climate-related impacts, this does not necessarily mean the species is an endangered or threatened species as defined under the Act. If a species is listed as endangered or threatened, this knowledge regarding its vulnerability to, and impacts from, climate-associated changes in environmental conditions can be used to help devise appropriate strategies for its recovery.

Global climate change, and the related warming of global climate, have been well documented (Bates 2008, ISAB 2007, WWF 2003). Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (Bates 2008, Battin *et al.* 2007), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, Hari *et al.* 2006, Rieman *et al.* 2007). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (WWF 2003). The range of many species has shifted poleward and elevationally upward.

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007) although the scale of that variation may exceed that of States.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer, drier areas such as is found on the eastside of the Cascade Mountains. Bisson *et al.* (2003) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate.

It is not certain what climate change means for *H. venusta*. If it indeed affects the frequency and magnitude of wildfires, available habitat may increase as trees and understory shrubs that shade *H. venusta* are eliminated. On the other hand, if precipitation lands primarily as rainfall rather than snow, soil moisture may become a limiting or causal factor.

Extreme rainfall events may tend to cause an increase in mass wasting events that could cause burying of the population or cause *H. venusta* habitat to slough down slope. Small surface erosion events and large landslides on the unstable slope where the *H. venusta* population is located are a continuing threat to the species. The steepness of the slope exceeds 100 percent (45 degrees) inclination in many places, and the slope's instability constitutes a significant threat as a major landslide could bury most of the population (Gamon 1997).

2.4 Synthesis

H. venusta occurs only in a relatively small area of the Tumwater Canyon on a particular set of substrates. As documented in the final rule listing *H. venusta* as endangered, this species was listed because of threats such as fire suppression, invasives, herbicide and road de-icer use along the main highway, and landslides. The majority of the habitat identified for *H. venusta* occurs on U.S. Forest Service lands, where monitoring and management actions are being implemented. The U.S. Forest Service is currently working on incorporating *H. venusta* into its habitat management plan. Fire suppression continues to impact the species' habitat, and research on *H. venusta* is complicated by the small size and vulnerability of the population, and the low seed production and germination rates of the species. Stochastic events continue to be a concern given the unpredictable nature of the environment in which *H. venusta* grows. Due to the small area and narrow habitat occupied by this species, the threats identified at listing continue to exist. Additionally, new threats, including potential impacts from climate change have been identified. Therefore, *H. venusta* should remain listed as endangered at this time.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- Extinction*
- Recovery*
- Original data for classification in error*
- No change is needed**

Brief Rationale:

See Synthesis above. *Hackelia venusta* should remain listed as endangered as it occupies a relatively small, narrow habitat, the threats identified at listing continue to exist and new threats, including potential impacts from climate change have been identified.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Continue efforts for establishing additional populations of *H. venusta*. This work will require refining propagation and reintroduction methods, and continuing to search for potential sites for outplanting the species. This includes continuing to collect and store genetically representative samples of seeds and determining optimal germination requirements.

Dr. Darlene Zabowski, Soil Science Professor at the University of Washington, has proposed a study of soil requirements for *H.venusta*. This study may help to clarify the substrate requirements of this species. As researchers have shown with other species, the success or failure of small outplantings in different sites may also provide a useful indicator of habitat requirements for the species (Dunwiddie 2010, Lawrence and Kaye 2009), Taylor 2008, WNHP 2007).

As the next step in monitoring, it would be useful to establish a yearly record of temperature, rainfall, and soil moisture. Together with annual pollinator censuses and assessments of the general condition of plants, it might then be possible to find patterns of pollinator abundance or scarcity, and relate them to seed set on *H. venusta* in the context of environmental conditions.

Continue the examination of life history: reproductive/pollination biology, seed production, germination requirements, seedling establishment, life span.

Investigate the natural history of *H. venusta* - What was its potential historic range? Could the white-flowered population have been at higher elevations at one time?

Continue to study the effects road de-icer formulas have on *H. venusta*.

Resolve the taxonomy of *H. venusta* and *H. "taylori"* and provide an appropriate name for these high elevation plant populations of conservation concern.

Continue work to improve the existing population and reduce the threats to the species sufficient to accomplish increases in population size and geographic distribution across its presumed historical range so that the species is no longer in danger of extinction.

Continue investigations for potential suitable habitat for *H. venusta* to find potential reintroduction sites, with emphasis on studying sites that have been found to be promising such as Icicle Canyon, and other sites within two miles radius of the extant site.

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Signature Page
U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF
HACKELIA VENUSTA (SHOWY STICKSEED)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: Remains as 5

Review Conducted By: Carrie Cordova, Eastern Washington Field Office, Spokane, Washington

Ken S. Berg Date 9/30/2011
Manager, Washington Fish and Wildlife Office, Fish and Wildlife Service