

Desert Yellowhead

(Yermo xanthocephalus)

5-Year Review:

Summary and Evaluation



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Wyoming Ecological Services

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5-YEAR REVIEW

Species reviewed: Desert Yellowhead (*Yermo xanthocephalus*)

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5-YEAR REVIEW

Desert Yellowhead (*Yermo xanthocephalus*)

1. 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) of 1973, as amended (16 U.S.C 1531 et seq.) 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 the time it was listed or since the most recent 5-year review. Based on the outcome of the 5-year review, we recommend whether the species should: 1) be removed from the list of endangered and threatened species; 2) be changed in status from endangered to threatened; 3) be changed in status from threatened to endangered; or 4) remain unchanged in its current status. Our original decision to list a species as endangered or threatened is based on the five threat factors described in section 4(a)(1) of the ESA. These same five factors are considered in any subsequent reclassification or delisting decisions. In the 5-year review, we consider the best available scientific and commercial data on the species, and we review 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 that includes public review and comment.

1.2. Reviewers

Lead Regional Office: Mountain-Prairie Region (Region 6)

Mike Thabault, ARD Ecological Services, (303) 236-4210

Bridget Fahey, Chief of Endangered Species, (303) 236-4258

Seth Willey, Regional Recovery Coordinator, (303) 236-4257

Kathy Konishi, Assistant Regional Recovery Coordinator, (303) 236-4212

Lead Field Office: Wyoming Ecological Services

R. Mark Sattelberg, Field Supervisor, (307) 772-2374 x234

Tyler Abbott, Deputy Field Supervisor, (307) 772-2374 x231

1.3. Methodology Used to Complete the Review

On June 20, 2011, we published a Notice of Review in the *Federal Register* (76 FR 35906) soliciting any new information on the *Yermo xanthocephalus* (desert yellowhead) that may have a bearing on its classification as endangered or threatened. For the purposes of this document, we will refer to *Yermo xanthocephalus* as "desert yellowhead." We did not receive any comments regarding desert yellowhead in response to the Federal Register notice. This 5-year review was primarily written by the Wyoming Ecological Services Field Office. It summarizes and evaluates information provided in the recovery outline, current scientific research, and surveys related to the species. All

pertinent literature and documents on file at the Wyoming Ecological Services Field Office were used for this review (See References section below for a list of cited documents). We interviewed individuals familiar with desert yellowhead as needed to clarify or obtain specific information.

1.4. Background

1.4.1. Federal Register notice citation announcing initiation of this review

76 FR 35906; June 20, 2011

1.4.2. Listing history

Original Listing

Federal Register notice: 67 FR 11442; March 14, 2002
(effective April 15, 2002)

Entity listed: Species

Classification: Threatened rangewide

1.4.3. Associated rulemakings

Critical Habitat Designation

Federal Register notice: 69 FR 12278; March 16, 2004

1.4.4. Review History

The status of desert yellowhead has not been formally reviewed since its listing in 2002. The species' status was evaluated in the February 2010 recovery outline (Service 2010).

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

At the start of the 5-year review, the Recovery Priority Number for desert yellowhead was 7. This number indicated that: (1) the species faces a moderate degree of threats, (2) the species has a high potential for recovery, and (3) the species is within a monotypic genus.

Table 1. The below ranking system for determining Recovery Priority Numbers was established in 1983 (48 FR 43098; September 21, 1983, as corrected in 48 FR 51985; November 15, 1983).

Degree of Threat	Recovery Potential	Taxonomy	Priority	Conflict
High	High	Monotypic Genus	1	1C
		Species	2	2C
		Subspecies/DPS	3	3C
	Low	Monotypic Genus	4	4C
		Species	5	5C
		Subspecies/DPS	6	6C
Moderate	High	Monotypic Genus	7	7C
		Species	8	8C
		Subspecies/DPS	9	9C
	Low	Monotypic Genus	10	10C
		Species	11	11C
		Subspecies/DPS	12	12C
Low	High	Monotypic Genus	13	13C
		Species	14	14C
		Subspecies/DPS	15	15C
	Low	Monotypic Genus	16	16C
		Species	17	17C
		Subspecies/DPS	18	18C

A “Moderate” degree of threats means desert yellowhead will not face extinction if recovery is temporarily held off, although there is continual population decline or threat to its habitat. Desert yellowhead is ranked as having “High” recovery potential as the biological and ecological limiting factors are well understood and easily alleviated, intensive management is not needed, or techniques to recover this species are well documented with a high probability of success. Desert yellowhead is the only species within the genus *Yermo* and is therefore within a monotypic genus. Finally, recovery of desert yellowhead is not in conflict with construction, other development projects, or other forms of economic activity (48 FR 43098; September 21, 1983).

1.4.6. Recovery Plan [or Outline]

Name of plan [or outline]: Recovery Outline for *Yermo xanthocephalus*
(desert yellowhead)

Date approved: February 25, 2010

Dates of previous revisions, if applicable: N/A

2. REVIEW ANALYSIS

2.1. Application of the 1996 Distinct Population Segment (DPS) Policy

This section of the 5-year review is not applicable to this species because the ESA precludes listing Distinct Population Segments (DPS) of plants. For more information, see our 1996 DPS policy (61 FR 4722; February 7, 1996).

2.2. Recovery Planning and Implementation¹

2.2.1. Does the species have a final, approved recovery plan?

- Yes
 No

2.2.2. Adequacy of recovery plan?

A final, approved recovery plan has not been developed.

2.2.3. Progress toward recovery

Since the time of listing, the Bureau of Land Management (BLM) has worked with the Service in order to lessen or remove threats to desert yellowhead and its habitat (See Section 2.3.2. for more information). All suitable habitat has been surveyed for additional desert yellowhead plants and populations (See Section 2.3. for more information). Censuses have been conducted from 1995 through 2004 and also from 2010 through 2012 (See Section 2.3.1.3. for more information). Additional studies on the soils, growth/life, and basic genetics have also been conducted (See Section 2.3. for more information).

A recovery outline for desert yellowhead was finalized in February 2010. The recovery outline did not include information from a BLM Information Memorandum published January 25, 2010. This memorandum discussed cooperative work between the BLM and the Service on efforts to move towards

¹ Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species, and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

the delisting of desert yellowhead (BLM 2010a). These efforts include funding a population viability analysis conducted by the University of Wyoming, in cooperation with Wyoming Natural Diversity Database (WYNDD). The results of this study are expected in 2013 and will help to guide our path forward.

If the path forward includes a recovery plan, it will include objective, measurable criteria which, when met, will result in a determination that the species can be removed from the Federal List of Endangered and Threatened Plants. Recovery criteria should address all threats impacting the species. Additionally, the recovery plan should estimate the time required and the cost to carry out those measures needed to achieve the goal for recovery and delisting. The scope of the plan will be single species (Service 2010).

2.3. Updated Information and Current Species Status

Since the discovery of desert yellowhead in 1990, this species was only known to exist at one location (hereafter referred to as the “Sand Draw” population). Much of the surrounding suitable habitat was surveyed without locating any additional plants or population (Fertig 1995; Heidel 2002; Fertig and Thurston as cited in Heidel et al. 2011). In order to identify any remaining survey gaps, Wyoming Natural Diversity Database (WYNDD) and the BLM’s Wyoming State Office partnered on a research project using various distribution models (Heidel et al. 2011). These models identified forty potential locations that had not been surveyed in prior years. During surveys conducted in 2010, a new population of desert yellowhead was discovered approximately 8.0 km (5.0 mi) from the Sand Draw population (Heidel 2010, pers. comm.; Heidel et al. 2011). This new population (hereafter referred to as the “Cedar Rim” population) consists of eight subpopulations and is located on the same geological formation as the Sand Draw population (Heidel et al. 2011; Heidel 2012b, pers. comm.). The area between these two populations was subsequently resurveyed; however, no additional desert yellowhead plants were found. Together, the Sand Draw and Cedar Rim populations comprise the entire known distribution of desert yellowhead.

2.3.1. Background on the species

2.3.1.1. Taxonomic classification or changes in nomenclature

Desert yellowhead was discovered by botanist Robert Dorn in the Beaver Rim area of central Wyoming in 1990 (Dorn 1991). Dorn estimated approximately 500 plants occurred in 1.0 hectare (ha) (2.5 acres (ac)) of sparsely vegetated, sandy hollows among sandstone outcrops. He determined this unusual plant was a member of the Aster family (Asteraceae). Upon closer examination and research, Dorn realized that the species had not been previously described and represented a new genus. Dorn (1991) described and named his discovery *Yermo xanthocephalus*, or literally “desert yellowhead.”

Asteraceae is one of the largest plant families in the world and is comprised of many tribes (Heidel 2002). Since the original species description, more recent taxonomic work has indicated that not only is *Yermo xanthocephalus* the only member of a monotypic genus, *Yermo*, but it is the only Wyoming species in a new subtribe Tussilagininae (Cass.) (Dumort) (Barkley 1999). Preliminary results from a study comparing six species of subtribe Tussilagininae showed the specimens of desert yellowhead has less variation as a species than some other members of the subtribe (Van Vleet 1996, as cited in Scott and Scott 2009). Additionally, desert yellowhead did not overlap with the other species. In other words, individual desert yellowhead plants are very similar to each other, but very different from other Asteraceae species within the same subtribe.

2.3.1.2. Biology and life history

Species Description: Desert yellowhead is a tap-rooted perennial herb. The entire plant is smooth, possessing no hair or other projections. The stems have leathery leaves and grow up to 30 centimeters (cm) (11.8 inches (in.)) tall. The leaves grow in an alternating pattern and are often folded along the vein in the middle of the leaf. Flower heads are numerous (25 to 180) and crowded on top of the stem. Each flower head contains four to six yellow disk flowers (ray flowers are absent) surrounded by four to six yellow, keeled involucre bracts (modified leaves below the flower head). The seeds have tufts of white hairs (Dorn 1991, Heidel 2002, and Heidel et al. 2008)

In the field, desert yellowhead can be recognized by its erect, leafy stems, leathery smooth or toothed leaves, rayless yellow flower heads, and yellow, keeled involucre bracts (Fertig 1995; Heidel 2002). Desert yellowhead is morphologically distinct from other members of the Aster family and other members of the subtribe Tussilagininae (Scott and Scott 2009). Rayless *Senecio* (ragworts and groundsels, Asteraceae family) species that can occur in Wyoming, (such as *Senecio hydrophilus* (water ragwort) and *Senecio rapifolius* (openwoods ragwort)) superficially resemble desert yellowhead. However, they can be distinguished by their green involucre bracts (Fertig 1994; 1995).

Life History: Desert yellowhead is a long-lived perennial that produces sexually by seed and asexually by vegetative buds (Scott and Scott 2009). At least some desert yellowhead plants have a lifespan of a minimum of 21 years (Scott and Scott 2009). This species is typically described as a classic 'K' selected species, characterized by a long-lived perennial growth form, adaptation to severe habitats, and low annual reproductive output (Fertig 1995).

Desert yellowhead usually flowers from mid-June to August and may prolong flowering, or flower for a second time in September (Heidel

2002). The growing season has an average of 124 days (Scott and Scott 2009). This species is likely pollinated by visually-oriented insects attracted to its bright disk flowers and bracts (Dorn 1991). Ants and nectar-feeding butterflies were noted as frequent visitors to desert yellowhead flowers (Heidel et al. 2011). The butterfly was identified as the small wood nymph (*Cercyonis oetus*), a common species in Wyoming that typically feeds on the nectar of yellow composite flowers. Additionally, small skipper butterflies (Hesperiidae family) visit desert yellowhead; however, these butterflies were not identified to species (Scott and Scott 2009).

Flowering levels of desert yellowhead appear to decline in drought years; however, no specific studies have been conducted. Preliminary inferences regarding seed dispersal include the capacity for wind or water dispersal (Dorn 1991; Heidel 2002). The hairy seeds mature in the latter half of summer when they are dispersed by wind (Heidel et al. 2011).

Researchers at the University of Wyoming are planning to establish plots to study seedling establishment and survival, as well as seed bank dynamics. However, due to the discovery of the Cedar Rim population and subsequent additional work required for the demographic study, this part of the research has not yet begun and completion may depend on available funding (Doak 2012a, pers. comm.).

Habitat: The occupied habitat of the Sand Draw population of desert yellowhead is restricted to shallow depressions created by erosion in outcrops of Miocene sandstones and limestones of the Split Rock Formation at its junction with the White River Formation (Van Houten 1964; Love 1961). These depressions accumulate drifting snow and may be more moist than surrounding areas. The vegetation of these sites is typically sparse, less than 10 percent, and consists primarily of low cushion plants and scattered clumps of *Oryzopsis hymenoides* (Indian ricegrass) (Fertig 1995; Heidel et al. 2011). Additionally, there is an abrupt border between the occupied habitat of the Sand Draw population and the surrounding sagebrush steppe (Heidel et al. 2011).



Habitat of the Sand Draw population

Photo by the U.S. Fish & Wildlife Service

Conversely, the Cedar Rim population does not occur on an outwash; the seven subpopulations occupy a narrow band along escarpment slopes (Heidel et al. 2011). These slopes are generally south-facing, mostly at the intersection between the cushion plant rim and sagebrush grassland toeslope communities on gravelly silt loam derived from the White River Formation (Heidel and Handley 2010, as cited in Heidel et al. 2011). Vegetation cover consists of 5 to 20 percent bunchgrasses, including *Pseudoroegneria spicata* (bluebunch wheatgrass) and *Koeleria cristata* (junegrass), accompanied by diverse forbs (broad-leaved herbs). Therefore, the habitats of the two populations differ not only in their topographic positions (mid-slope vs. base), but also in vegetation structures (bunchgrass community vs. barren cushion plant community) (Heidel et al. 2011).



Habitat of the Cedar Rim population

Photo by B. Heidel-WYNDD, used with permission

Soils: Desert yellowhead plants in the Sand Draw population are almost exclusively found on poorly developed soils and only occasionally on more well-developed soils (Scott and Scott 2009). Where they are found on well-developed soils, they occur a meter or less from the soils without a well-developed soil profile. Soils within the Sand Draw population had a higher silt content, were slightly more alkaline, slightly lighter in color, had lower loss on ignition organic matter, and had lower water retaining capacity than soils outside of the population (Scott and Scott 2009; Heidel et al. 2011). The soils within the Sand Draw population are distinct from those of the surrounding steppe by at least 8 of the 17 soil properties that were tested (Heidel et al. 2011). These results supported the hypothesis that desert yellowhead is a habitat specialist and is limited in distribution by soil characteristics.

In 2010, additional soil sampling was conducted. This additional sampling supported the original hypothesis that the soils of the Sand Draw population of desert yellowhead differs from the soils of the surrounding sagebrush steppe. However, 10 of the 17 soil properties tested showed differences between the soils of the Sand Draw population and the soils of the Cedar Rim population. In all tests except available phosphorus, the soils of the Sand Draw population differed more from the soils of the Cedar Rim population than they did from one or both of the surrounding steppe soils and the potential site soils (Heidel et al. 2011). Only one soil variable, the soluble sodium level, was found to be similar between the two populations of desert yellowhead. These results do not support the hypothesis that desert yellowhead is a habitat specialist that is limited in distribution by soil characteristics.

An alternate hypothesis states if desert yellowhead was once widespread and experienced a range restriction, the species could be likely to be found in different habitats with a dispersal pattern independent of dispersal patterns (Heidel et al. 2011). The results of the additional soil sampling support the first part of this hypothesis. However, as discussed below under Section 2.3.1.3. The second part of this hypothesis, the pattern of distribution of desert yellowhead, is not supported. Therefore, additional research is needed to determine whether desert yellowhead has always had a restricted range or if the species once had a broader range that has become restricted.

Climate: Local climate data (1948 to 1977) was available from a National Climatic Data Center weather station located approximately 14.5 air km (9 air mi) north of the Sand Draw population of desert yellowhead (Heidel 2002; Scott and Scott 2009). In 1994, a weather station was installed near the highest density of desert yellowhead plants within the Sand Draw population. This site was located away from the annual snowdrifts that formed along the west rim of the shallow erosional

depression.

Data collected from 1994 through 1998 within the Sand Draw population of desert yellowhead showed:

- Most of the annual precipitation occurs during the months of April, May, and June.
- Precipitation from April through June ranged from 6.58 to 23.80 cm (2.58 to 9.37 in.).
- Average monthly temperatures were hottest in July or August, with the coolest average monthly temperatures occurring in December, January, and February, but occasionally March.
- The relative humidity fluctuates between a value near zero to at or near 100 percent relative humidity at least one diurnal cycle per month.
- Daily average wind temperatures were generally 16.1 km per hour or less (10 mi per hour or less); with a southerly wind occurring most frequently.

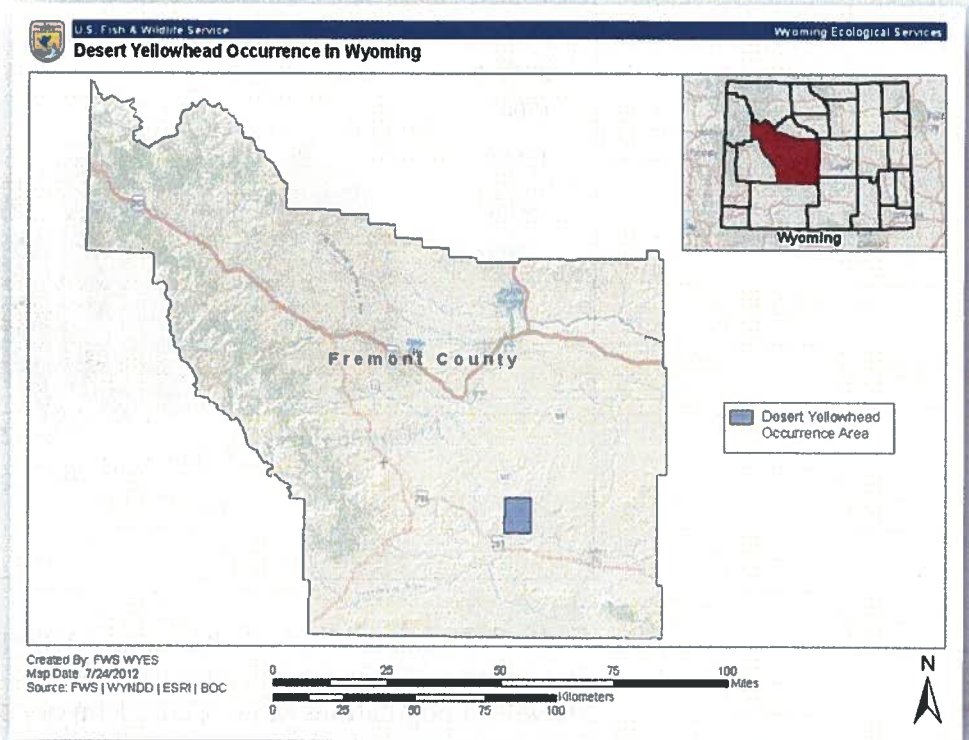
2.3.1.3. Distribution, abundance, and trends

Distribution: The Sand Draw population consists of one large subpopulation at the base of Cedar Rim and two smaller subpopulations approximately 0.4 km (0.25 mi) away. The Sand Draw population covers an area of 20 hectares (ha) (49.4 acres (ac)) (Heidel 2002; Scott and Scott 2009). However, the occupied area of the Sand Draw population is only 3.5–4.4 ha (8.5–10.9 ac) (Scott and Scott 2009; Heidel et al. 2011).

The recently discovered Cedar Rim population consists of eight subpopulations. The subpopulations are separated by distances of over 10 m (32.8 ft), but all located within a 0.40 km (0.25 mi) long area (Heidel et al. 2011; Heidel 2012b, pers. comm.). The Cedar Rim population occupies an area of less than 0.4 ha (1.0 ac) (Heidel et al. 2011). Therefore, the total area occupied by the physical footprint of the two populations of desert yellowhead is approximately 4.8 ha (11.9 ac). Both populations occur entirely on land managed by the BLM's Lander Field Office.

As noted above (Section 2.3.1.2 Climate), the Sand Draw site is sheltered with an overall southerly wind direction between July and September. This wind pattern provides a potential pathway for seed dispersal from the Sand Draw population to the Cedar Rim population (Heidel et al. 2011). Additionally, the distribution of the subpopulations of the Cedar Rim population can be seen as separate colonization events along a downwind slope of the same geological formation (Heidel et al. 2011).

Figure 1: Distribution of desert yellowhead

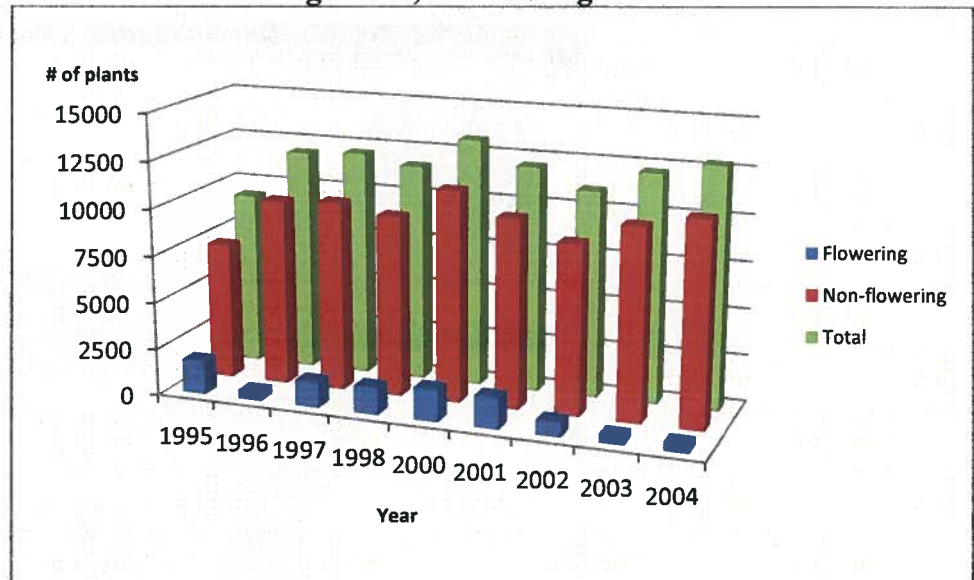


Abundance and Trends:

Sand Draw population: Originally, Dorn (1991) estimated that there were approximately 500 plants within 1 ha (2.5 ac). However, this was a visual estimate (likely weighted toward flowering plants) and is not considered a rigorous estimate of the population size at that time. Therefore, this estimate should not be used to assess population trends over time. Furthermore, we have no information on historic range or abundance of desert yellowhead for comparison.

Between 9,294 and 13,247 individual desert yellowhead plants have been counted at the Sand Draw population during the period 1995 through 2004 (Scott and Scott 2009). During that period, the population lost or gained as few as 188 plants or as many as 1,182 plants, while fluctuating around an annual mean of 11,813 plants. Flowering plant densities were consistently less than 20 percent of the total densities. During the study, the species did not expand outside the existing footprint of more than a few meters.

Figure 2: Census of the Sand Draw Population of desert yellowhead, 1995 through 1998, 2000 through 2004



Cedar Rim population: The Cedar Rim population of desert yellowhead was surveyed following its discovery in 2010. At that time, the seven known subpopulations of the Cedar Rim population were conservatively tallied as containing at least 400 plants. The eighth subpopulation was discovered and mapped during the 2011 field season (Heidel 2012b, pers. comm.). However, the data from the 2011 field season has not been compiled at this time.

Heidel et al. (2011) noted a more complex spatial pattern of the desert yellowhead plants within the Cedar Rim population. The Cedar Rim population has areas of higher density than is typical within the Sand Draw population. However, the Cedar Rim population was surveyed using the same census procedures from prior censuses (Scott and Scott 2009). Therefore, all shoots that had overlapping leaf cover at the time of monitoring were treated as part of the same plant. Additionally, those procedures counted two plants as the same individual if there was 15 cm (5.9 in) or less separation distance (Heidel et al. 2011). This may have resulted in a lower population count for the Cedar Rim population than actually existed. Heidel et al. (2011) noted that additional plant growth would change the survey results, for example if the survey was conducted later in the growing season. Currently, we only have one year of census data for the Cedar Rim population.

Research: A demographic study was conducted on the two populations of desert yellowhead in 2010 and is projected to continue through 2012. If funding is available, the study may continue through the 2013 field season (Doak 2012a, pers. comm.; Doak 2012b, pers. comm.). This study is designed to produce a population viability analysis for the species. In

2010, transect surveys documented 998 plants in the Sand Draw population and 346 plants in the Cedar Rim population. These transect counts do not represent a complete census of the populations and treatment of plants with overlapping leaves is not described. Census data will be used for fine-scale mapping of plants, to understand density dependence of this species, and its role in limiting numbers and stabilizing densities (Doak 2012a, pers. comm.).

2.3.1.4. Critical Habitat

On March 16, 2004 (69 FR 12278), approximately 146 ha (360 ac) of Federal land managed by the BLM in Fremont County, Wyoming was designated as critical habitat for desert yellowhead. This designation became effective on April 15, 2004. Critical habitat receives protection under section 7 of the ESA through the prohibition against destruction or adverse modification of critical habitat with regard to actions authorized, funded, or carried out by a Federal agency.

Unoccupied habitat was not designated. At that time, there was no evidence that desert yellowhead had ever occurred outside of the occupied area. Prior to the designation of critical habitat, surveys of similar habitat in the area surrounding the Sand Draw population had not found any additional plants. In light of these facts, the Service did not feel that there was sufficient basis regarding the conservation needs of the species to designate habitat outside of the known geographic range. The newly discovered Cedar Rim population expanded the known range of desert yellowhead. As such, the Cedar Rim population does not occur within the previously designated critical habitat.

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

At the time of listing, threats to the Sand Draw population of desert yellowhead included surface disturbances caused by oil and gas development, mineral extraction, and soil compaction by vehicles, as well as the potential for introduction of invasive species (70 FR 40053; July 12, 2005). Since the time of listing, additional information on predation, diseases, and climate change has been examined, as discussed below.

Oil and Gas Development: When desert yellowhead was listed, habitat destruction caused by oil and gas development was listed as the most severe and immediate threat to the species. In 1996 and 1997, prior to the discovery of desert yellowhead, the BLM granted leases for oil and gas development for a tract that encompassed the Sand Draw population and adjacent areas. Applications for four permits to drill were also filed. Of these, two were permitted in 1998 on pre-existing well pads. These leases were for a 10-year period and were allowed to expire in 2006 and 2007 without being developed or disturbed. Future proposals for development actions pursuant to the Mineral Leasing Act of 1920 and the Federal Onshore Oil and Gas Leasing Reform Act (1987) would first require lands to be leased again.

The BLM has worked with the Service since the desert yellowhead was listed to minimize the threat the species from oil and gas development. In 2005, the BLM committed to apply Conditions of Approval prohibiting all surface-disturbing activities on all Applications for Permit to Drill within the population and critical habitat of desert yellowhead (Service 2005). Additionally, a maintenance action to the BLM's Lander Resource Management Plan (RMP) adopted the updated Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities. This action provided that no activities would be permitted in habitat for threatened and endangered species that would jeopardize the continued existence of such species (BLM 2011). Furthermore, it provided that neither surface disturbing activities nor surface occupancy will be allowed in known threatened or endangered species habitat. This maintenance action protects both the Sand Draw population and the Cedar Rim population from surface disturbing activities and surface occupancy. Additionally, the Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities is included in the current revisions to the RMP (BLM 2011a; Oberlie 2012a, pers. comm.). Moreover, the BLM maintains the authority and discretion to offer or defer leasing in the area depending on an appropriate National Environmental Policy Act (NEPA) analysis of the potential effects to the species and its designated critical habitat.

In summary, the BLM has committed to conservation measures to protect desert yellowhead and its habitat. The BLM's adoption of the updated Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities protects all threatened or endangered species habitats from surface disturbing activities and surface occupancy (BLM 2011). All known locations of desert yellowhead benefit from these guidelines. Additionally, any leased activities with the potential to affect desert yellowhead and its habitat would be reviewed under NEPA and section 7 of the ESA.

Based on conservation actions by the BLM, oil and gas development are considered to be low in severity and magnitude and not an immediate threat to the species. If desert yellowhead is proposed to be delisted, the Wyoming BLM Standard Mitigation Guidelines for Surface Disturbing Activities would not apply as the protections of this document are for federally threatened and endangered species. Instead, it is anticipated that the Service would request the BLM continue to apply Conditions of Approval on Applications for Permit to Drill within the populations of desert yellowhead prohibiting all surface disturbing activities. Additionally, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Section 2.3.2.4. for further discussion). Therefore, in the absence of protections under the ESA, we anticipate that the threat from oil and gas development would remain low in severity and magnitude and not an immediate threat to the species.

Mineral Extraction: When desert yellowhead was listed, mineral extraction was listed as a potential threat to the species. Locatable mineral resources, such as opals, gold, uranium, and zeolites, exist in the Beaver Rim area (67 FR 11442; Service 2010). Private parties can stake a mining claim, explore for, and extract locatable minerals in accordance with the 1872 General Mining Law. The BLM's authority to regulate mineral claims under the 1872 General Mining Law is limited, although mining activities with five or more acres of surface disturbance of unpatented BLM land are required to have an approved operating plan under 43 CFR 3809.

In 2005, a large deposit of opal was discovered near Cedar Rim. When this discovery was publicized, more than 1,000 mining claims were registered at the Fremont County Courthouse in two months (BLM 2009c, as cited in BLM 2011a). To address this threat, the BLM issued a 20-year protective withdrawal of the 146 ha (360 ac) desert yellowhead critical habitat from settlement, sale, location, or entry under the general land laws, including mining laws, subject to valid existing rights (73 FR 5586; January 30, 2008). Therefore, the Sand Draw population of desert

yellowhead is protected by a 20-year withdrawal from surface entry and mining. However, the withdrawal does not include leasing under the mineral leasing laws. Nor does this withdrawal include the habitat occupied by the Cedar Rim population. This 20-year withdrawal from surface entry and mining will expire, unless renewed, on January 10, 2028.

Under the 1872 General Mining Laws, a person staking a locatable mineral claim is not required to file the required paperwork prior to physically staking a claim on BLM land and potentially conducting limited surface disturbing activities. Therefore, the staking of locatable mineral claims in or near the plant's habitat could occur. If a claim was staked within the Sand Draw population, the person filing the claim would be informed the area was withdrawn from locatable mineral claims when they filed their mining claim. However, persons familiar with the process of staking mineral claims will typically research the area of interest prior to conducting field work (Stiles 2012, pers. comm.). Claims have been staked within the same Township, Range, and Sections as the Cedar Rim population; however, there are no physical claim stakes within or in the immediate vicinity of the population (Oberlie 2012c, pers. comm.). Additionally, no signs of land use disturbance were noted during the 2010 field season (Heidel et al. 2011). The closest claims are located approximately 0.8 km (0.5 mi) from the Cedar Rim population (BLM 2012a). For the Sand Draw population, the closest active claims are over 0.8 km (0.5 mi) from the plants (BLM 2012b). The newest claim on record in the vicinity of the desert yellowhead populations was filed in 2009 (BLM 2012a; 2012b). Additionally, none of these claims have resulted in a Notice of Intent being filed with the BLM. A Notice of Intent is required for conducting up to 2 ha (5 ac) of mining activity (Oberlie 2012c, pers. comm.).

After the discovery of the Cedar Rim population, the Service and the BLM discussed the possibility of pursuing a protective withdraw for the area surrounding the Cedar Rim population. However, due to habitat characteristics, small occurrence size of the Cedar Rim population, and the lack of a perceived threat of actual mining despite some mining claims staked in the area, the Service and the BLM determined that pursuing a protective withdrawal for the Cedar Rim population would not provide additional protections (Oberlie 2012b, pers. comm.; Oberlie 2012d, pers. comm.).

Based on these factors, we consider the threat from mineral extraction to be low in severity and magnitude and not an immediate threat to the species. In the absence of ESA protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see

Section 2.3.2.4. for further discussion). Additionally, if desert yellowhead is proposed to be delisted, it is anticipated that the Service would enter into discussions with the BLM prior to the delisting to determine whether the withdrawal should remain in effect. Therefore, in the absence of protections under the ESA, we anticipate that the threat from mineral extraction would remain low in severity and magnitude and not an immediate threat to the species.

Motor Vehicles and Off-Road Vehicles: When desert yellowhead was listed, motor vehicles and off-road vehicles/off-highway vehicles were determined to be a threat to the species through the crushing of plants, destruction of seeds, and compaction or erosion of soil. This threat has the greatest impact in the spring and summer when plants are in flower or with fruit. Both populations of desert yellowhead are located in close proximity to the Cedar Rim Road and Wyoming State Highway 135. A two-track road bisects the Sand Draw population and dead-ends at an abandoned oil well. Individuals of desert yellowhead have been found growing within the roadbed (Scott and Scott 2009).

To address these threats, the BLM announced the closure of certain BLM-administered public lands to all types of motor vehicle use, effective March 16, 2005 (70 FR 40053; July 12, 2005). The closure affects public lands located within, and adjacent to, the 146 ha (360 ac) designated critical habitat of desert yellowhead. Therefore, the two-track road that bisects the Sand Draw population is closed to all types of motor vehicle use. Maps of the closure area were initially posted at the BLM's Lander Field Office and at key locations near the closure area (70 FR 40053). The road-bed has been allowed to revert to natural vegetation. This closure will remain in effect until the threat to the desert yellowhead population and its critical habitat by motorized vehicles has ceased (70 FR 40053).

This closure only protects the Sand Draw population of desert yellowhead and its critical habitat. The Cedar Rim population was not known at the time of issuance and is therefore not covered under the closure. However, botanists have not found any signs of land-use disturbance within the Cedar Rim population. Moreover, no effects to the population were noted from existing roads or pipelines (Heidel et al. 2011). The habitat of the second population is located mid-slope along an escarpment. This location makes it less likely to be affected by illegal cross-country vehicular travel.

The prohibition on motor vehicle use within the Sand Draw habitat and critical habitat of desert yellowhead provides some protection to the species. Additionally, the BLM's Lander RMP motor vehicle policy provides some protection to both populations of the species, as it requires

that all motorized vehicles remain on established roadways. While the BLM does not have the staffing levels to adequately police all BLM-managed lands, no illegal use has been noted in or near either population.

Based on these factors, we consider the threat from motor vehicles and off-road vehicles to be low in severity and magnitude and not an immediate threat. In the absence of ESA protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Section 2.3.2.4. for further discussion). Additionally, if desert yellowhead is proposed to be delisted, it is anticipated that the Service would enter into discussions with the BLM prior to the delisting to determine whether the road closure should remain in effect. In general, motor vehicle policies on Federal lands have been moving towards more strategic transportation plans, closing excess roads and trails. We anticipate that these roads would remain closed. Therefore, in the absence of protections under the ESA, we anticipate that the threat from motor vehicles and off-road vehicles would remain low in severity and magnitude and not an immediate threat to the species.

Invasive Species: Nonnative species were listed as a possible threat to desert yellowhead in the listing decision. Desert yellowhead occurs on relatively barren sites with less than 25 percent total vegetative cover and may be intolerant of competition (Fertig 1995). Competition from plants not native to the area could pose a greater threat than competition from species with which desert yellowhead has evolved. Prior to 2010, no nonnative plants had been identified within or in the general vicinity of desert yellowhead (Scott and Scott 2009; Heidel et al. 2011). During surveys of the Cedar Rim population, one nonnative species, *Alyssum desertorum* (desert madwort), was found in one plot (Heidel et al. 2011). Currently, the Fremont County Weed and Pest (FCWP) do not officially designate *A. desertorum* as an invasive species or a species of concern (FCWP 2012a; 2012b).

Invasive species could be introduced to the habitat of desert yellowhead by domestic livestock, native ungulates, on the tires of vehicles during illegal use of the area, on footwear or clothing of humans visiting the area, or by wind or water transportation of seeds of invasive species. This threat will likely be ongoing. Several invasive species have been noted within 6.4 km (4 mi) of the Sand Draw population of desert yellowhead (Scott and Scott 2009). Three species, *Hyoscyamus niger* (black henbane), *Cardaria* spp. (whitetop), and *Centaurea repens* (Russian knapweed) occur within 1.6 km (1 mi) of the Sand Draw population (Scott and Scott 2009).

Through the Service's Biological Opinion on the BLM's Lander Resource Management Plan (Service 2005), the BLM has committed to implement several conservation measures for the protection of desert yellowhead including:

- Develop and implement a monitoring plan for the species and its designated critical habitat. The plan will include regular patrol of the site for unlawful uses of the land, and the monitoring of invasive weed populations. This plan also would include, but is not limited to, the inventory and monitoring of all vehicle access to the area for the purpose of restricting access of vehicles that pose a threat to the species.
- Prohibit biological control of weeds in the species' habitat until the impacts of the control agent has been fully evaluated and determined not to adversely affect the plant population.

Through the above actions and the closure of the critical habitat to motor vehicles and off-road vehicle traffic, the level of threat from invasive species has been reduced to low in severity and magnitude and is not an immediate threat. In the absence of ESA protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Section 2.3.2.4. for further discussion). If desert yellowhead is proposed for delisting, it is anticipated that the Service would enter into discussions with the BLM prior to the delisting to determine appropriate conservation measures to ensure continued protection of the species. Therefore, in the absence of protections under the ESA, we anticipate that the threat from invasive species would remain low in severity and magnitude and not an immediate threat to the species.

In summary, we consider the threats of oil and gas development, mineral extraction, motor and off-road vehicles, and invasive species to be low in severity and magnitude. In the absence of the protections under the ESA, we anticipate that the BLM would continue to implement conservation measures and the threats from oil and gas development, mineral extraction, motor and off-road vehicles, and invasive species would remain low in severity and magnitude and not an immediate threat to the species.

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

At the time of listing, the potential for overutilization for commercial, recreational, scientific, or education purposes was unknown. It was noted that due to the small extant population size and habitat, desert yellowhead is vulnerable to overutilization. Additionally, the leaves of desert yellowhead contain a chemical that produces a mild numbing sensation in

the human mouth when even tiny portions are tasted. This characteristic could indicate potential medicinal qualities that could prove attractive to pharmaceutical companies (67 FR 11442). Medicinal values of related species within the subtribe Tussilaginatae have been documented (Scott and Scott 2009). Unauthorized collections could take place; however, extensive field surveys of this species have reported no evidence of this occurring.

Currently, the Service has authorized two permits allowing the collection of desert yellowhead (TE083524-0 and TE-74610A). These permits are for both scientific and educational purposes and include: (1) the collection and mortality of four whole plants, all from the Sand Draw population of desert yellowhead; (2) collection of samples for a genetic and population viability analysis, no more than 2 leaves from 20 to 25 multi-stemmed individuals from 1 or both of the populations of desert yellowhead; and (3) collection of seed material from 20 to 25 desert yellowhead from 1 or both populations for viability analysis. Additionally, no more than 50 individuals per population shall be sampled. This level of impact for scientific purposes is compatible with the recovery of the species.

In summary, we have no evidence that overutilization for commercial or recreational purposes is occurring. Furthermore, we conclude that the permitted activities for educational and scientific purposes do not rise to the level of a threat to the species. If desert yellowhead is proposed to be delisted, we anticipate less interest in the plant for educational and scientific purposes. Additionally, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Section 2.3.2.4. for further discussion). Therefore, in the absence of protections under the ESA, overutilization is not anticipated to be a threat to the species.

2.3.2.3. Disease or predation

At the time of listing, no information was given on the threat of disease to the population of desert yellowhead. Cattle and wild ungulate grazing was listed as a possible threat to the species. However, only a few observations of grazing or browsing on desert yellowhead have been noted. These observations indicated that the plant was not ingested and was discarded nearby (Heidel 2002). Additionally, insect predation was listed as a concern in the fruit production during the 1990 field season. The extent of historical predation on desert yellowhead was unknown; therefore, at the time of listing the degree of threat from this factor was determined to be unknown.

Disease: In August 2010, botanists noticed a few desert yellowhead plants had turned chlorotic (the yellowing or whitening of normally green plant tissue because of a decrease amount of chlorophyll, often as a result

of disease or nutrient deficiency) (Heidel et al. 2011). This condition appeared to cause mortality; however, it developed after flowering and did not affect reproduction. More than one subpopulation contained plants that were chlorotic (Heidel 2012a, pers. comm.). We have no other reports of disease. Therefore, the threat of disease is considered to be low in severity and magnitude and not an immediate threat. In the absence of protections under the ESA, the severity, magnitude, and immediacy of this threat are not anticipated to increase.

Livestock and Wild Ungulate Grazing and Trampling: At the time of listing, grazing and trampling were listed as possible threats to the species. Livestock appeared to use the habitat within the Sand Draw population as a travel corridor between adjacent sagebrush-grassland pastures to some extent (Fertig 1995). Signs of moderate horse traffic have been noted adjacent to the Sand Draw population (Scott 2000). Additionally, some trampling of plants, including some in flowering or early fruiting condition, has been observed (Heidel 2002; Scott and Scott 2009). Cattle graze in the immediate vicinity, but observations indicate that the plant is not palatable to grazers (Heidel 2002; Scott and Scott 2009). The primary threat of grazers appears to be from trampling. As desert yellowhead is unpalatable, desert yellowhead may benefit from some level of grazing through reduced competition with other more palatable species.

No barriers prevent livestock or wildlife access to either population. Fencing of the areas could protect the plants from trampling threats. This option was previously discussed with the BLM. However, it was determined that an unmaintained or poorly built fence could result in wildlife or livestock being trapped within the site. Additionally, the exclusion of grazers would likely result in a change in the associated plant community. This change could result in unanticipated adverse impacts to desert yellowhead. The plants and their surroundings have been subject to some degree of grazing by domestic herbivores for over 100 years; wild herbivores have grazed these areas even longer (Service 2005). A better understanding of the impacts and benefits of grazing would be necessary before considering any modifications to current grazing pastures.

The BLM has committed to implement several conservation measures with regard to grazing for the protection of the Sand Draw population of desert yellowhead. These measures are detailed to in the U.S. Fish and Wildlife Service's (Service) Biological Opinion on the BLM's Lander Resource Management Plan (Service 2005). The conservation measures include: (1) The BLM will not increase current permitted livestock levels; (2) The BLM will not approve location of mineral supplements or additional water sources for livestock, wild horses, or wildlife on public lands within 3.2 km (2 mi) of the site; (3) No supplemental feeding or straw placement can be done without proper authorization (43 CFR 4140

(a)(3)); and (4) Livestock will not be intentionally herded within 0.8 km (0.5 mi) of the Sand Draw population of desert yellowhead or in designated critical habitat. Additionally, the BLM will not conduct wild horse management actions (e.g., temporary gathering/holding facilities) within designated critical habitat.

As a result of these conservation measures, the threat of grazing and trampling by wild ungulates and/or cattle is low in severity and magnitude and the threat is not immediate. In the absence of ESA protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Section 2.3.2.4. for further discussion). Additionally, if desert yellowhead is proposed to be delisted, it is anticipated that the Service would enter into discussions with the BLM prior to the delisting to determine appropriate conservation measures to ensure continued protection of the species. Therefore, in the absence of protections under the ESA, the threat of grazing and trampling by wild ungulates or cattle is likely to remain low in severity and magnitude and not an immediate threat to the species.

Other Predation Threats: At the time of listing, only ant predation on the fruits of desert yellowhead was detailed as a potential threat from predation. In subsequent field observations, an occasional desert yellowhead plant was lost due to the digging activity of badgers (Scott and Scott 2009). Ants were also noted to be frequent visitors to flowering desert yellowhead plants, apparently feeding on nectar (Heidel et al. 2011). We have no information on historic interactions between these animals and desert yellowhead plants. However, we also do not have any data to suggest that the current level of predation activities are above what would be expected in a normally functioning ecosystem. Therefore, we consider the interactions with these animals to be natural events and not a threat to the species. In the absence of the protections under the ESA, we do not anticipate a change in this threat level.

In summary, we consider the threats of disease, grazing, and trampling due to wild ungulates and livestock to be low in severity and magnitude. We do not consider the negative effects from natural ecological interactions with other predators to rise to the level of a threat. In the absence of the protections under the ESA, we anticipate that the BLM would continue to implement conservation measures and the threats from disease, grazing, and trampling would remain at a low level. Additionally, we do not anticipate any changes to the level of interactions with other predators.

2.3.2.4. Inadequacy of existing regulatory mechanisms

At the time of listing, the State of Wyoming had no laws to provide protection to plant species, the BLM's Lander RMP did not mention desert

yellowhead as it had been approved prior to the plant's discovery, and desert yellowhead was not listed on BLM's sensitive species list. The BLM's Lander RMP protects special status plant species and provides no surface occupancy restrictions for threatened and endangered species impacted by oil and gas development. However, this protection did not apply to desert yellowhead until the species was listed under the ESA, effective on April 15, 2002. A summary assessment of the level of threat from inadequacy of existing regulatory mechanisms was not made in the final listing rule.

Currently, desert yellowhead and its habitat are afforded protections through the Endangered Species Act (ESA), the National Environmental Policy Act (NEPA), and policy and planning documents of the BLM. Below, we analyze the current situation (i.e., the situation with the ESA's protections in place) and, in order to gauge the adequacy of regulatory mechanisms, what would happen in the absence of the protections of the ESA.

Federal Regulations

Endangered Species Act: Since desert yellowhead was listed in 2002, the ESA is the primary Federal law providing protection for this species. The ESA includes a number of regulatory provisions that provide protections to desert yellowhead. These include:

Section 4: Section 4 of the ESA allows for the provision of such protection to threatened species through regulation. This protection applies to desert yellowhead and confers its status as a threatened species and provided the designation of critical habitat. Additionally, this section directs the development of recovery plans and regular review for listed species.

Section 6: Funding may be available through section 6 of the ESA for the States to conduct recovery activities. However, a recovery plan has not been developed to guide recovery activities. Additionally, desert yellowhead occurs only on BLM-managed lands.

Section 7: Section 7 of the ESA states that Federal agencies, in consultation with the Service, shall carry out programs for the conservation of endangered species. Section 7(a)(1) requires Federal agencies consult with the Service if they determine that any of their authorized actions may affect a listed species. Section 7(a)(2) requires Federal agencies to consult with the Service to ensure any project they fund, authorize, or carry out is not likely to jeopardize the continued existence of listed species or modify their critical habitat. Desert yellowhead is only known to occur on land managed by the BLM. We

have previously consulted with the BLM on the Lander RMP regarding the potential impacts to desert yellowhead and its critical habitat (Service 2005).

Section 9: The ESA and the Service's implementing regulations set forth a series of general prohibitions and exceptions that apply to all threatened plants. All prohibitions of section 9(a)(2) of the ESA, implemented by 50 CFR 17.71, apply. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or remove the species to possession from areas under Federal jurisdiction or in violation of any State law. Additionally, collection of listed plants or activities that would damage or destroy listed plants on Federal lands are prohibited without a Federal permit.

Section 10: The ESA also provides for the issuance of permits to carry out otherwise prohibited activities involving threatened plants under certain circumstances. Such permits are available for scientific purposes and to enhance the propagation or survival of listed species. For threatened plants, permits also are available for botanical or horticultural exhibition, educational purposes, or special purposes consistent with the purposes of the ESA. Currently, the Service has authorized two permits allowing the collection of desert yellowhead (TE083524-0 and TE-74610A), as described above under Section 2.3.2.2.

Other Federal Protections:

National Environmental Policy Act: The National Environmental Policy Act (NEPA) (42 U.S.C. 4371 et seq.) provides some protections for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies (Federal nexus). Prior to implementation of such projects with a Federal nexus, NEPA requires an agency to analyze projects for potential impacts to the human environment, including natural resources. In cases where the analysis reveals significant environmental effects, the Federal agency must discuss mitigation that could offset those effects (40 CFR 1502.16). These mitigations usually provide some protections for listed species. However, NEPA does not require that adverse impacts be mitigated, only that impacts be assessed and the analysis disclosed to the public.

In the absence of the ESA's protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer (see Bureau of Land Management section below for further discussion). BLM biologists consider BLM sensitive species during NEPA analysis of a

project. Additionally, it is anticipated that the Service would have discussions with the BLM prior to the delisting to determine appropriate conservation measures to ensure continued protection of the species.

Bureau of Land Management

Federal Land Policy and Management Act: The Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. 1701 et seq.) governs the management of the public lands administered by the BLM. Section 102(a)(8) of the Federal Land Policy and Management Act states public lands will be managed, in part, to provide protection to ecological and environmental resources. The BLM is required to establish a planning process for the management of public lands that accommodates multiple uses of the land and its resources and achieves sustained yields of natural resources.

Resource Management Plans: Resource Management Plans (RMP) are the basis for all actions and authorizations involving BLM-administered lands and resources. They establish allowable resource uses, resource condition goals and objectives, program constraints, general management practices, general implementation sequences, and standards for monitoring and evaluating the plan to determine its effectiveness and that need for amendment or revision (43 CFR 1601 et seq.). Desert yellowhead occurs within the BLM Lander Field Office's management area. The BLM's Lander RMP protects special status plant species and provides no surface occupancy restrictions for threatened and endangered species impacted by oil and gas development. Additionally, the current draft of the Lander RMP:

- Prohibits staging fire suppression vehicles in or driving fire suppression vehicles through the desert yellowhead populations;
- Maintains the locatable mineral withdrawal of the desert yellowhead critical habitat;
- Prohibits surface-disturbing activities and applies a no-surface occupancy stipulation to mineral leasing activities within the Cedar Rim population of desert yellowhead; and
- Closes the critical habitat of desert yellowhead to motorized travel.

Most of these restrictions were included in amendments to the 1987 Lander RMP. These stipulations through the RMP represent an enforceable regulatory mechanism to ensure that the species and its habitat are considered during the permitting process and other decisions on BLM lands. These stipulations will remain in effect, once the draft RMP is signed, until the next revision process. RMPs are typically revised every 15 to 20 years. During the next revision, it is anticipated that the BLM

will enter into discussions with the Service regarding conservation measures for desert yellowhead.

BLM Sensitive Species: Manual 6840 - Special Status Species Management (6840 Manual) directs the BLM to manage habitat for all sensitive species in a manner that will ensure that all actions authorized, funded, or carried out by the BLM shall further the conservation and/or recovery of federally listed species and the conservation of BLM sensitive species (BLM 2010b). The BLM considers impacts to these species during project planning stages and conservation measures may be included at the discretion of agency biologists.

The 6840 Manual directs the designation of the BLM's sensitive species to include native species found on BLM-administered lands for which the BLM has the capacity to significantly affect the conservation status of the species through management, and either: (1) there is a risk to the viability of the species, or (2) the species depends on ecological refugia or specialized or unique habitats on BLM-administered lands, and there is evidence that such areas are threatened with alteration such that the continued viability of the species in that area would be at risk. Furthermore, the 6840 Manual states that all federally designated candidate species, proposed species, and proposed to be delisted species in the 5 years following their delisting shall be conserved as BLM sensitive species (BLM 2008, BLM 2010b).

Therefore, the BLM currently protects desert yellowhead as a sensitive species and in the absence of the ESA's protections, the BLM will protect desert yellowhead for a period of at least 5 years following delisting. Furthermore, as desert yellowhead is only known to occur on BLM-administered lands, it meets the requirements per the BLM's 6480 Manual to retain designation as a BLM sensitive species even past the 5-year standard.

Information Memorandum: These are memorandums that disseminate information of interest to BLM employees. The BLM published an Information Memorandum on January 25, 2010. This memorandum discussed cooperative work between the BLM and the Service on efforts to move towards the delisting of desert yellowhead (BLM 2010). These efforts include funding a population viability analysis conducted by the Wyoming Natural Diversity Database and the University of Wyoming. This memorandum, while not regulatory, shows the BLM's commitment to work with the Service on conserving desert yellowhead and its habitat.

BLM Closure of Public Lands to Motorized Vehicle Use: On July 12, 2005, the BLM published a notice in the Federal Register announcing the closure of certain BLM-administered public lands to all types of motor

vehicle use to protect desert yellowhead and its critical habitat (70 FR 40053). The closure affects public lands located within, and adjacent to, the 146 ha (360 ac) designated critical habitat of the Sand Draw population of desert yellowhead. This closure became effective on March 16, 2005, and remains in effect until the threat to Sand Draw population of desert yellowhead and its critical habitat by motorized vehicles has ceased.

As noted above, under the Resource Management Plans heading, this closure has been incorporated into the Lander RMP. The original closure remains in effect as long as desert yellowhead remains listed under the ESA. The RMP closure will remain in effect until the next RMP revision and would be considered in the revision process. Therefore, in the absence of protections under the ESA, the closure would remain in effect for at least 15 to 20 years. At that time, it is anticipated that the Service would enter into discussions with the BLM to determine appropriate conservation measures to ensure continued protection of the species. The BLM has demonstrated their willingness to work with the Service on conserving desert yellowhead and its habitat.

State Implemented Regulatory Mechanisms: Wyoming does not have State-level endangered plant laws or other laws that protect desert yellowhead.

Local Conservation Planning: There are no county or local laws or regulations protecting desert yellowhead.

In summary, the ESA currently provides adequate protections to desert yellowhead. In the absence of ESA protections, the BLM's 6840 Manual Sensitive Species designation would provide some protections to the species for five years following delisting and potentially longer. Furthermore, the draft Lander RMP provides several protections for desert yellowhead and its critical habitat. These protections will remain in effect for 15 to 20 years. When the RMP is revised or if desert yellowhead is considered for delisting, it is anticipated that the Service would enter into discussions with the BLM prior to the delisting to determine which conservation measures should remain in place and if any further conservation measures should be implemented. Therefore, in the absence of protections under the ESA, it is anticipated that the desert yellowhead would be protected by sufficient regulatory mechanisms.

2.3.2.5. Other natural or manmade factors affecting its continued existence

At the time of listing, desert yellowhead was thought to be more vulnerable to the documented threats due to its small population size and restricted distribution. In-breeding and low genetic diversity were also

mentioned as potential threats to the species. Climate change was not considered in the threats assessments of the original listing determination.

Small Population Size: An inherent vulnerability for desert yellowhead is its small population size and restricted distribution. Species with small population size and restricted distribution are vulnerable to extinction by natural processes and human disturbance (Levin et al. 1996). For example, random events causing population fluctuations or population extirpations become a serious concern when the number of individuals or the geographic distribution of the species is very limited. Similarly, a single human-caused or natural environmental disturbance (extreme weather event) could destroy an entire population of desert yellowhead.

The existence of three subpopulations within the Sand Draw population and discovery of the Cedar Rim population, with eight subpopulations, may provide some additional protection to the species. However, the two populations are located within 8.0 km (5 mi) of each other. There is a small possibility that both populations could be destroyed during one larger-scale event, for example if the Yellowstone volcano became active and a large-scale eruption occurred. However, such an event is unlikely in the foreseeable future. The species' low reproductive output also increases the risk of effects from random disturbance events, as it is unlikely that the species will be able to rebound quickly (e.g., exhibit a high rate of population growth), even if environmental conditions improved after such an event.

While small population size remains an issue of concern, there is no evidence that the plant has occurred outside of the area currently occupied or in substantially larger numbers any time in the recent past. More information on this issue is required to assess the degree of this vulnerability. Specifically, we need to improve our understanding of the species demographics to assess the risk associated with the species' limited distribution and small population size. An ongoing study (mentioned above in Section 2.3.1.) conducted through the University of Wyoming aims to provide demographic information on both populations of desert yellowhead and develop a population viability assessment.

Genetic Vulnerability: Populations of plants that remain very small for several generations or populations that have gone through a past episode of rapid population decline may lose much of their previous genetic variability (Godt et al. 1996). The loss of genetic variability may reduce a species ability to respond to changing environmental conditions. In addition, the potential for inbreeding depression increases. Inbreeding depression can decrease fertility and survival rates. Although environmental and demographic factors usually supersede genetic factors in threatening species viability, inbreeding depression and the low genetic

diversity may enhance the probability of extinction of rare plant species (Levin et al. 1996). On the other hand, some plant species have shown no evidence of inbreeding depression, despite low genetic diversity.

There are a lot of unknowns regarding the historical distribution and genetic viability of desert yellowhead and how these issues affect the species. However, monitoring of desert yellowhead has not indicated that any of these factors are currently causing a decline in the species. At this time, we do not have enough information regarding the small population size and genetic vulnerability of desert yellowhead. Recommendations to improve our knowledge are included in Section 4.

Climate Change: According to the Intergovernmental Panel on Climate Change (IPCC) (2007) “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.”

Since the release of the IPCC report, new evidence that our planet is experiencing significant and potentially irreversible changes has underscored reasons for concern (Smith et al. 2009). In the United States, we are seeing a multitude of changes consistent with a rapidly warming climate. Climate change impacts in the United States summarized by the U.S. Global Change Research Program in Global Change Impacts in the United States (Karl et al. 2009) include:

- U.S. average temperature has risen more than 2 degrees Fahrenheit over the past 50 years and is projected to rise more in the future; how much more depends primarily on the amount of heat-trapping gases emitted globally and how sensitive the climate is to those emissions.
- Precipitation has increased an average of about 5 percent over the past 50 years. Projections of future precipitation generally indicate that northern areas will become wetter and southern areas, particularly in the West, will become drier.
- The amount of rain falling in the heaviest downpours has increased approximately 20 percent on average in the past century, and this trend is very likely to continue, with the largest increases in the wettest places.
- Many types of extreme weather events, such as heat waves and regional droughts, have become more frequent and intense during the past 40 to 50 years.

These changes are already having a considerable impact on species and natural systems, including changes in the timing of biological events (i.e., phenological changes), such as the onset and end of breeding seasons, migration, and flowering; shifts in geographic ranges; and changes in

community dynamics and populations (Glick et al. 2011).

The ecological impacts associated with climate change do not exist in isolation, but combine with and exacerbate existing stresses on our natural systems. Vulnerability to climate change has three principle components: sensitivity, exposure, and adaptive capacity (Glick et al. 2011; Dawson et al. 2011). Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli (US CCSP 2008). Exposure is the nature and degree to which a system is exposed to significant climate variations (IPCC 2001 as cited by Glick et al. 2011). Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC 2001).

As noted above, in Section 2.3.1.2., climatic data (1948-1977) is available from a climate station, approximately 14.5 km (9 mi) north of the Sand Draw population of desert yellowhead. Site specific weather data was collected for the Sand Draw population revealing the climate at the Sand Draw population of desert yellowhead was not as extreme as the researches had expected (Scott and Scott 2009). However, this data has not been analyzed to evaluate potential climatic change trends. University of Wyoming researchers will be placing micro-temperature loggers within the two desert yellowhead populations to gather additional data regarding summer temperatures and plant locations in relation to snow pack (Doak 2012a, pers. comm.). Additionally, researchers will be examining annual weather drivers for determining stochasticity (randomness) of the density-dependence of the desert yellowhead plants within the population (Doak 2012a, pers. comm.).

In general, a trend of warming in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, and reduce summer flows (IPCC 2007). While this change could affect desert yellowhead and its habitat, to date, a negative impact has not been documented. A significant degree of uncertainty exists as to how projected climate changes, alone and in concert with other threats, will affect the desert yellowhead or its habitat in the future. While fewer cold days and nights could result in increased vegetative yield in colder environments, increased summer heat and areas affected by drought may increase (IPCC 2007).

Desert yellowhead is adapted to a low moisture environment that is susceptible to flooding and erosion events. However, we have limited evidence of reduced reproduction in drought conditions. More research on the drought tolerance of the species is needed. Another factor to consider regarding desert yellowhead's ability to adapt to climate change is the

species' origin. Several hypotheses have been proposed (Heidel 2002, Scott and Scott 2009). The hypothesis most often cited is that desert yellowhead is a relict species that has become restricted in its distribution. This hypothesis is supported by the extreme restricted distribution pattern of desert yellowhead and the absence of the species on similar adjacent surfaces. However, the fact that the Sand Draw population and the Cedar Rim population differ in several habitat conditions supports the hypothesis that desert yellowhead was once more widespread and its distribution has become restricted (Heidel et al. 2011). If this second hypothesis is correct, the species may be more adaptable as it has survived through a variety of selective pressures. Conversely, if desert yellowhead has a more recent origin and has always occupied a restricted habitat, the species may not be able to adapt well in the face of changing climatic conditions. More studies on this species' responses to changes in climate need to be completed. Overall, it appears possible that the desert yellowhead or its habitat may be affected negatively by climate change.

2.4. Synthesis

At the time of listing, threats from oil and gas development and the species' limited habitat and population size were considered to be the greatest threats to desert yellowhead. Presently, the threats from oil and gas development have been largely removed due to various conservation measures by the BLM.

Other threats identified at the time of listing included: mineral extraction, motor vehicles and off-road vehicles, invasive species, overutilization, predation, grazing and trampling, small population size, and restricted distribution. Primarily through conservation measures implemented by the BLM, these threats have largely been reduced.

The entire known range of desert yellowhead consists of two populations on BLM-managed land in southern Fremont County, Wyoming. The Sand Draw population consists of a main population with two subpopulations and occurs on approximately 20 ha (49.4 ac). The Cedar Rim population consists of eight subpopulations and occurs in an area of less than 0.5 ha (1.2 ac). However, this species' physical occurrence footprint covers an area of less than 4.8 ha (11.9 ac). The Sand Draw population has ranged from 9,294 to 13,247 individuals during the survey period of 1995 through 2005 (Scott and Scott 2009). We only have one year of survey data from the newly discovered Cedar Rim population. The discovery of the Cedar Rim population has provided some protections to offset the threats of small population size and restricted distribution; however, unknowns still exist. Additionally, the discovery of the Cedar Rim population, located approximately 8.0 km (5 mi) from the Sand Draw population, provides some protection to the species in the event of a small scale catastrophic event. However, it does not remove this threat.

We need to improve our understanding of the species demographics and genetics to assess the vulnerabilities of this species (See Section 4 for more information).

3. RESULTS

3.1. Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist** (Indicate reasons for delisting per 50 CFR 424.11):
 - Extinction
 - Recovery
 - Original data for classification in error
- No change is needed

A population viability assessment is currently being conducted. Results are expected following the 2013 field season. Depending on the results of that assessment, a classification change may be recommended at that time.

3.2. New Recovery Priority

The primary threats to desert yellowhead have been addressed through conservation measures implemented by the BLM. We do not have enough information to accurately determine the degree to which some potential threats (i.e., genetic vulnerability and climate change) may be affecting desert yellowhead. However, the effects of these threats are not evident by examining the available population trend data. The discovery of the Cedar Rim population shows an expansion of range and ability of the species to survive in a wider range of habitat conditions than previously thought.

Based on our 5-year review analysis, we recommend changing the Recovery Priority Number for desert yellowhead. The remaining threats to the species are low in severity and magnitude and not immediate. A “low” degree of threats means desert yellowhead is rare, or is facing a population decline which may be a short-term, self-correcting fluctuation, or the impacts of threats to the species’ habitat are not fully known (48 FR 43098; September 21, 1983). The recovery potential remains high and the taxonomy of the species has not changed. Finally, recovery of the species is not in conflict with construction, other development projects, or other forms of economic activity. Therefore, we recommend changing the Recovery Priority Number for desert yellowhead to 13.

4. RECOMMENDATIONS FOR FUTURE ACTIONS

In late 2009, desert yellowhead was identified by the BLM as a species that has a high likelihood of delisting upon completion of recovery tasks (BLM 2010a). Criteria used in the selection of species included the species primarily occurring on BLM-managed lands where the threats are known and currently being managed. BLM and the Service agreed to work cooperatively towards a goal of delisting desert yellowhead.

Since this agreement, BLM has funded studies through the Wyoming Natural Diversity Database including surveys of all potential suitable habitat and additional soil testing. The Lander BLM is currently revising their RMP and has included several measures to ensure the long-term protection of desert yellowhead.

Furthermore, the BLM has assisted with funding the demographic study currently being conducted by the University of Wyoming. This study is designed to provide a population viability analysis. The results of this study will assist the Service in determining whether to recommend this species for delisting or proceed with developing a recovery plan. In making that determination, the Service will also enter into discussions with the BLM to determine what level of conservation measures they would agree to implement if the species is proposed to be delisted. Any new developments in the knowledge of climate change effects in the Beaver Rim area of Fremont County, Wyoming will also be considered.

Recovery Plan: If a recovery plan is determined to be necessary, the recovery plan should include objective, measurable criteria which, when met, will result in a determination that the species can be removed from the Federal List of Endangered and Threatened Plants. Recovery criteria should address all threats meaningfully impacting the species. Additionally, the recovery plan should estimate the time required and the cost to carry out those measures needed to achieve the goal for recovery and delisting. The scope of the plan will be single species. The recovery effort should build on ongoing conservation efforts.

Additional Research Needed:

- Determine why desert yellowhead occurs in some areas of apparently suitable habitat and not in others.
- Conduct modeling to clarify the factors affecting long-term population viability (population demographics and genetics).
- Continue research into desert yellowhead's life history and ecology (e.g., identify pollinators).
- Investigate and project desert yellowhead's response(s) to climate changes.
- Analyze the genetic diversity of desert yellowhead.
- Continue work on the mycorrhizal symbiosis of desert yellowhead.
- USGS paleobotanical microslides taken from the Split Rock Formation show pollen from an unidentified Compositae (as cited in Scott and Scott 2009). Additional effort should be made to track down these slides or conduct additional studies.

1. POLYMERIZATION OF VINYL MONOMERS

In the first part of the course we have seen how a vinyl monomer can be polymerized to a polymer. This is done by a process called free-radical polymerization. The first step is the initiation of the reaction, which is done by a free radical. This radical then attacks the double bond of the monomer, forming a new radical. This process repeats itself until the reaction is complete.

The second part of the course is concerned with the kinetics of the polymerization reaction. This involves the study of the rate of the reaction and the factors that affect it. The rate of the reaction is determined by the concentration of the monomer and the concentration of the free radical.

The third part of the course is concerned with the molecular weight of the polymer. This is determined by the length of the polymer chain. The molecular weight of the polymer is affected by the concentration of the monomer and the concentration of the free radical. The molecular weight of the polymer is also affected by the presence of chain transfer agents.

The fourth part of the course is concerned with the structure of the polymer. This involves the study of the tacticity of the polymer. The tacticity of the polymer is determined by the arrangement of the monomer units in the polymer chain. The tacticity of the polymer is affected by the concentration of the monomer and the concentration of the free radical.

2. POLYMERIZATION OF VINYL MONOMERS

The first part of this section is concerned with the mechanism of the polymerization reaction. This involves the study of the steps involved in the reaction. The first step is the initiation of the reaction, which is done by a free radical. This radical then attacks the double bond of the monomer, forming a new radical. This process repeats itself until the reaction is complete.

The second part of this section is concerned with the kinetics of the polymerization reaction. This involves the study of the rate of the reaction and the factors that affect it. The rate of the reaction is determined by the concentration of the monomer and the concentration of the free radical. The rate of the reaction is also affected by the presence of chain transfer agents.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW OF DESERT YELLOWHEAD (*YERMO XANTHOCEPHALUS*)

Current Classification: Threatened rangewide

Recommendation resulting from the 5-Year Review:

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

Review Conducted By:

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 10.24.12
Field Supervisor, Wyoming Field Ecological Services

