STATUS REPORT ON

DESERT YELLOWHEAD (*YERMO XANTHOCEPHALUS*)

IN WYOMING

Illustration by Jane L. Dorn

Prepared for the Bureau of Land Management
Wyoming State Office and Rawlins District

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30 March 2002

COOPERATIVE AGREEMENT NO. KAA990027
TASK ORDER 4

Acknowledgements

Walter Fertig initiated this *Yermo xanthocephalus* survey and status report update as the original Wyoming Natural Diversity Database (WYNDD) botanist, provided all available WYNDD information resources on the species, and provided comments on the draft of this report. His original status report on the species is reflected throughout. Richard Scott (Central Wyoming College, Fremont County Weed Board) conveyed unpublished data and observations on the species and contributed detailed review of the draft of this report. Robert Dorn (Mountain West) patiently discussed his original work on the species. The *Yermo* illustration by Jane Dorn is reprinted from the Madrono monograph by Robert Dorn. Jeff Carroll (Bureau of Land Management) helped secure funding for the project.

Frank Blomquist (Bureau of Land Management) provided fieldwork coordination. Connie Breckenridge (Bureau of Land Management) and Mary Jennings (U.S. Fish & Wildlife Service) provided opportunities to discuss their technical reports on the species. Scott Laursen (WYNDD) prepared the maps of the species' location and the model of potential distribution. Jennifer Whipple and Charmaine Refsdal provided copies of their *Yermo* slides for technical use. Gary Beauvais, Director and WYNDD colleagues provided logistical support.

This report is a challenge cost-share project of the Bureau of Land Management and the Wyoming Natural Diversity Database.

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INTRODUCTION

This report represents an update of the prior status report (Fertig 1995) based on expanded surveys using a model of species' potential distribution, more recent research, and current status information. The chronology of research on the species and status changes are highlighted below.

While conducting field work in the Beaver Rim area of central Wyoming in 1990, botanist Robert Dorn discovered a small population of an unusual species of composite (Asteraceae). Further study revealed that the species was unknown to science and represented a new genus. Dorn (1991) named his discovery *Yermo xanthocephalus*, or literally "desert yellowhead".

Dorn estimated 500 plants in 2.5 acres of habitat in 1990. Due to its limited distribution, *Yermo xanthocephalus* was designated as a Category 2 (C2) candidate for listing under the Endangered Species Act by the US Fish and Wildlife Service (USDI FWS 1993).

A set of studies were initiated in 1992 by Richard and Beverly Scott (Central Wyoming State College). They include an annual population census, a monitoring of 50 plants each year to document phenology, a germination study, pollen characterization, developmental root morphology, soil chemistry analysis, and collection of environmental data including air temperature, relative humidity, wind direction, wind velocity, solar radiation, precipitation, and soil temperatures and soil moisture measurements at two depth intervals. In addition, a preliminary transplant study was initiated in 2000. A management response study is proposed for 2002 to evaluate species' response to trampling and fire. GPS mapping of the population boundaries, roads and surface features was initiated in 2000 (Scott 2000).

In 1994, the Wyoming State Office of the BLM and the Rawlins District Office contracted on a cost-share basis with Wyoming Natural Diversity Database (WYNDD) to conduct field surveys for *Yermo xanthocephalus* on public lands in central Wyoming (Fertig 1995). The objectives of this project were to collect information on the biology, distribution, habitat use, population size, and potential threats to this species to be used in guiding management decisions. In addition, a permanent monitoring plot was established and baseline demographic and population trend data were collected. Additional surveys for *Yermo xanthocephalus* were conducted by WYNDD in 1997, expanding the scope of baseline inventory.

Yermo xanthocephalus remained a C2 species under the Endangered Species Act from 1992 until February 1996. At that time, the C2 program was eliminated and the species on it dropped. It had no formal status for over a year until it was classified as a Candidate species, Priority 1, by the U.S. Fish & Wildlife Service in September 19, 1997 (USDI FWS 1997). On December 22, 1998, the U.S. Fish & Wildlife Service proposed listing it as Threatened under the Endangered Species Act (USDI FWS 1998). The Service solicited public comment and determined the species to be warranted for listing in 1999 (USDI FWS 1999).

The species only occurs on lands administered by the Bureau of Land Management Wyoming Office. Under Bureau of Land Management (BLM) Manual 6840, the BLM is directed to manage USFWS candidate species in such a manner that these species and their habitats are conserved and to ensure that agency actions do not contribute to the need to list these species as Threatened or Endangered

(Willoughby et al. 1992). In 2000, a draft conservation agreement and conservation strategy for *Yermo xanthocephalus* was proposed by the Bureau of Land Management Wyoming Office (Breckenridge 2000) to address threats and provide for species' conservation. No action was taken to make it final and it automatically expired in September 2001. The species has not been included in the new sensitive species list of the Bureau of Land Management Wyoming Office (USDI BLM 2001) because the species is automatically addressed by the BLM under the Endangered Species Act as a proposed or designated species.

In November, 2001, a lawsuit was filed by a coalition of conservation groups including Biodiversity Associates, Biodiversity Legal Foundation, Center for Native Ecosystems, Earth Justice Legal Foundation, and the Wyoming Outdoor Council to complete the listing procedure. On March, 14, 2002, the U.S. Fish & Wildlife Service determined *Yermo xanthocephalus* to be threatened under the Endangered Species Act, a decision that takes effect on April 15, 2002 (USDI FWS 2002).

METHODS

The *Yermo xanthocephalus* has been systematically surveyed in similar Beaver Rim and Cedar Rim outcrop habitat without finding additional populations (Fertig 1995). To broaden the survey beyond these outcrop rims, in 2001 the distinguishing characteristics of *Yermo xanthocephalus* habitat across its occupied habitat at one site were used to develop a model of potential habitat. The species grows in shallow, loamy soils of the Entisol order derived from Miocene volcanic deposits (Fertig 1995). This bedrock geology feature was mapped using the digitized state geology map (Green and Drouillard 1994) to identify areas of potential distribution within the primary Miocene volcanic deposits (White River Formation) in southeastern and southcentral Wyoming counties. This map of a single geological feature was used along with the source map (Love and Christiansen 1985) and the soil survey maps (Natural Resources Conservation Service 1983) to transcribe areas of potential habitat onto USGS topographic maps and BLM land status maps, for targeting potential habitat in a ground survey. The topographic maps were also used to identify outcrop settings, and the BLM surface management maps were used to determine access to public lands.

Surveys were conducted in the eight counties where these White River outcrops *() are most extensive. Intensive survey gaps were targeted on the contiguous segments of Beaver and Cedar Rim in Fremont County to visit likely habitat that had not been surveyed in 1994 or 1997. In addition, surveys were targeted in each of the other areas of extensive Miocene volcanic deposits throughout the eight counties.

Field surveys were conducted in 48 locales from July 3 to August 7, 2001. Survey routes and collection sites in Fremont County are indicated in Appendix B. Survey routes were recorded on BLM land status maps or 7.5' USGS topographic maps.

In 1994, a permanent monitoring transect was established by Fertig (1995) at the south end of Cedar Rim following the protocol of Lesica (1987). Complete documentation of transect establishment and results are provided in Fertig (1995). Population census work was initiated by Richard Scott in 1995, and the transect monitoring was not continued because the census provides comprehensive population trend information.

SPECIES INFORMATION

Classification

Scientific Name: *Yermo xanthocephalus* Dorn (Dorn 1991).

Common Name: Desert yellowhead

Family: Asteraceae (Sunflower Family); Senecioneae (tribe) of Asteraceae; Tussilagininae (subtribe) of Senecioneae.

Synonyms: None.

Phylogenetic Relationships: The species is in a monotypic genus in the Asteraceae. It is one of the few species in the Asteraceae having yellow involucral bracts. The Asteraceae is one of the largest plant families in the world, and is comprised of many tribes. The phylogenetic relationships of *Yermo xanthocephalus* within the Senecioneae Tribe and between nearest relatives in the Rocky Mountains are addressed by Dorn (1991), and revised by taxonomic treatments of Barkley (1999). Dorn (1991) considered *Yermo* to be most closely related to species of the *Cacalia* genus in the tribe Senecioneae. Species of *Cacalia* differ from *Yermo* in having green involucre bracts, fibrous or fleshy-fibrous roots, and whitish flowers. Most occur in wet habitats of eastern and mid-western North America, more than 1000 km east of the known habitat of *Yermo xanthocephalus*, though there are boreal and southwestern members (Barkley 1999).

More recently, the *Cacalia* genus *sensu lato* was elevated to a subtribe of the Senecioneae, the Tussilagininae (Cass.) Dumort, in revisionary work for the Flora of North America (Barkley 1999). The *Senecio* genus *sensu lato* was elevated to the subtribe *Senecioninae* (Cass.) Dumort. These revisions mean that *Yermo* is different from all other Wyoming species in the same tribe at the subtribe level, and not just the genus level. This signifies an even greater phylogenetic distance between the genus *Yermo* and all other Wyoming species in the tribe than originally identified by Dorn (1991).

The origin and genetic relations of this taxon have not been researched. A determination of chromosome number and ploidy levels may point to the nature of origin. The presence of this taxon as a monotypic genus and a highly isolated western member of the *Tussilagininae* suggest an ancient evolutionary origin rather than a recent one in keeping with patterns of endemism characterized in Stebbins and Major (1965).

Legal Status: *Yermo xanthocephalus* was originally listed as a Category 2 (C2) species by the US Fish and Wildlife Service (USDI FWS 1993). Category 2 includes taxa for which there is current evidence of vulnerability, but for which USFWS lacks sufficient biological data or field survey information to support a listing proposal. *Yermo xanthocephalus* remained a C2 species under the Endangered Species Act from 1992 until February 1996, with the elimination of the C2 program and recognition of all C2 species. It had no formal status for over a year until it was classified as a Candidate

species, Priority 1, by the U.S. Fish & Wildlife Service in September 19, 1997 (USDI FWS 1997). On December 22, 1998, the US Fish and Wildlife Service proposed listing it as Threatened under the Endangered Species Act (USDI FWS 1998). The Service solicited public comment and determined the species to be warranted for listing in 1999 (USDI FWS 1999).

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In November, 2001, a lawsuit was filed by a coalition of conservation groups including Biodiversity Associates, Biodiversity Legal Foundation, Center for Native Ecosystems, Earth Justice Legal Foundation, and the Wyoming Outdoor Council to complete the listing procedure. In March, 2002, the U.S. Fish and Wildlife Service determined *Yermo xanthocephalus* to be threatened under the Endangered Species Act, a decision that takes effect on April 15, 2002 (USDI FWS 2002).

Natural Heritage Rank: *Yermo xanthocephalus* is ranked G1 ("critically imperiled" throughout its range) in the Natural Heritage Network system (originally affiliated with The Nature Conservancy and now coordinated by NatureServe.) It is considered critically imperiled because of extreme rarity throughout its range (less than 5 extant occurrences are known). In Wyoming, this taxon is ranked S1 because of extreme rarity within the state (Fertig and Beauvais 1999), reflecting the fact that the species rangewide distribution and statewide distribution are the same.

Description: *Yermo xanthocephalus* is a tap-rooted, glabrous perennial herb with leafy stems to 12 inches (30 cm) high (Figures 1-4). The leathery leaves are alternate, lance-shaped to oval, 1 1/2-10 inches (4-25 cm) long and often folded along the midvein. Leaf edges are smooth or toothed. Flower heads are numerous (25-180) and crowded at the top of the stem. Each head contains 4-6 yellow disk flowers (ray flowers are absent) surrounded by five yellow, keeled involucre bracts. The pappus consists of numerous white bristles (description from Fertig 1995 and 2000; citing Dorn 1991 and 2001; and Fertig et al. 1994).

Figure 1. Line drawing of *Yermo xanthocephalus* from Dorn (1991). A. Habit. B. Individual head at left, top view of individual head in bud at right. C. Mature achene. D. Disk floret with pappus removed. E. Disk floret with pappus intact. *Illustration by Jane L. Dorn.*

Figure 2. *Yermo xanthocephalus* in bud.
Note: Central flowers are further advanced. The 2 rosettes at right would be censused as representing a separate individual.
Photo by Walter Fertig 21 June 1998

Figure 3. *Yermo xanthocephalus* close-up.
Note: One flower still in bloom (to the upper right of center), others in fruit. Note also the keeled, yellow involucral bracts.
Photo by Charmaine Refsdal

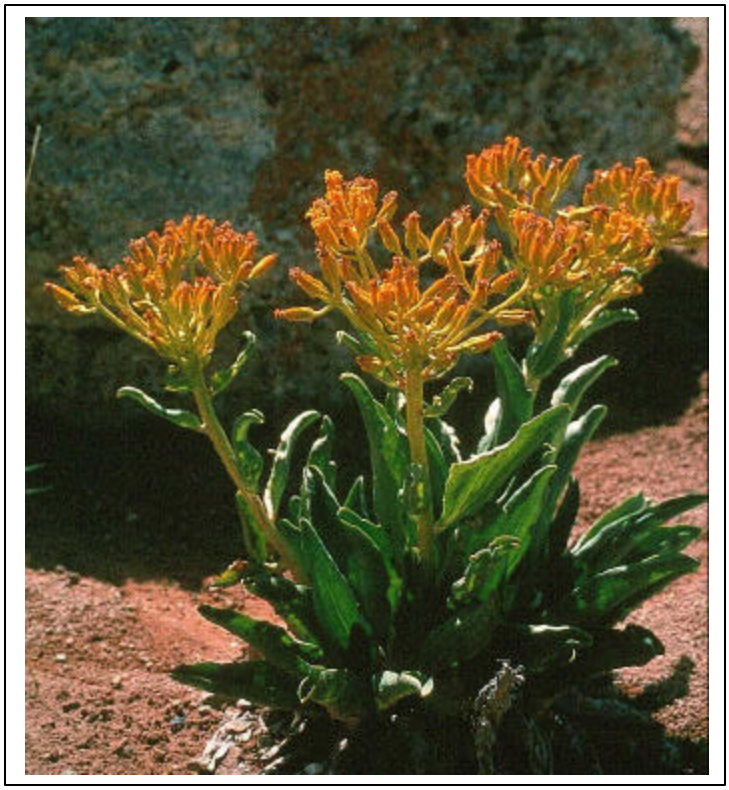


Figure 4. *Yermo xanthocephalus* in flower.
Note: The stout stems, leathery leaves, multi-stemmed growth form and vestiges of leaves from the previous year.
Photo by Jennifer Whipple

The technical description follows: Perennial herb, glabrous except sometimes the achenes. Stems hollow, to 3 dm high, 1 to several from a thick, elongate taproot. Leaves basal and alternate, petioled, coriaceous, lanceolate to ovate or obovate, entire to variously toothed, 4-25 cm long, 1-6 cm wide, gradually reduced upward, generally with a rounded fold lengthwise, the main three veins somewhat parallel. Heads numerous (25-180), in a crowded corymbiform cyme. Involucre cylindrical, 8-15 mm long, the bracts in a single series, (4) 5 (6), strongly keeled, the keel greenish-yellow, the rest bright yellow but drying pale, generally cucullate at tip, usually with a few much reduced bractlets at base. Receptacle naked, flat or sometimes with a sharp projection from center. Rays none. Disk florets usually as many as involucre bracts (4-6), barely exserted from involucre, yellow, the tube about 3 mm long, the throat about 2 mm long, the lobes linear, widely spreading and about 2 mm long. Anthers with a pair of minute lobes at base. Style branches obtuse-truncate and pubescent at tip, stigmatic surface covering entire inner face. Pappus copious, of capillary bristles, subequal to corolla tube and throat, borne on an expanded disk at top of achene, deciduous in fruit. Achenes short-pubescent, usually about 10 nerved, brown, 6-7 mm long, slightly flattened, elliptic to oblanceolate in outline (Fertig 1995 and 2000; adapted from Dorn 1991).

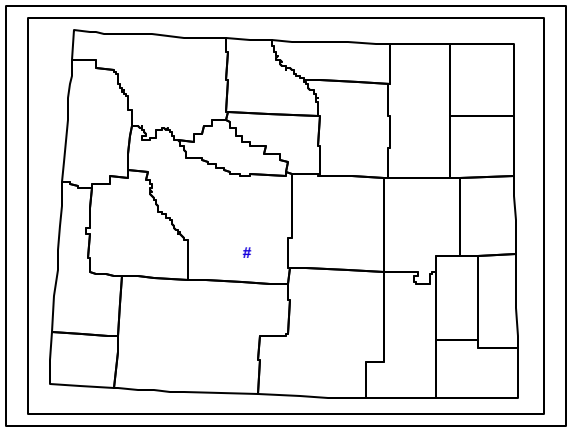
Yermo xanthocephalus usually flowers from mid-June to August and may prolong flowering, or flower again for a second time in September. The starting and ending of flowering and its duration vary between years, depending on temperature and climate (Richard Scott, personal communication to Bonnie Heidel). Individual plants also flower and fruit at slightly different times of the year, and their offset phenology extends the entire flowering period of the species (Dorn 1991). Despite such a long potential flowering period there can be late periods and shortened periods. Figure 2 shows a plant beginning to flower after the third week of June in 1998. By contrast, in a drought year visit on July 3, 2001, almost all plants had finished flowering. Fruits do not persist after the flower has dried and the bracts ruptured, but fruits have been observed on plants from mid July to early September (Fertig et al. 1994; RM records).

In the field, *Yermo xanthocephalus* can be recognized by its erect, leafy stems, leathery smooth or toothed leaves, rayless yellow flower heads, and yellow, keeled involucral bracts (Fertig 1995, 2000).

Similar Species: Rayless *Senecio* species (such as *S. hydrophilus* and *S. rapifolius*) superficially resemble *Yermo*, but can be distinguished by their more numerous green involucral bracts (Fertig et al. 1994, Fertig 1995).

Geographical Distribution: *Yermo xanthocephalus* is endemic to the Beaver Rim area on the western edge of the Sweetwater Plateau and Wind River Basin in southern Fremont County, Wyoming (Figure 5). The entire known range of the species occupies a space of 42.5 ac (17 ha), but the actual area that supports plants is 8.33 ac (3.27 ha; Scott 2002).

Figure 5. Distribution of *Yermo xanthocephalus*



This species is known only from the type locality, approximately 6 miles north of Sweetwater Station (Figure 6, Table 1). It is composed of three subpopulations that have been mapped using aerial photos. In addition, a road that comes from the northwest (not shown) cross part of the population and an access road to an exploratory well pad from the southwest (currently closed) runs close to a southeastern corner of a subpopulation. Both roadbeds have limited Yermo plants in them beyond the three subpopulation boundaries and are thought to represent colonization (Richard Scott personal communication to Bonnie Heidel). In 2002, Richard and Beverly Scott mapped the subpopulation boundaries, roads, and surface features using GPS units, which will provide a more accurate map product. Additional information on this single occurrence is provided in the Element Occurrence Record in Appendix A, and highlighted on Table 1.

There are no historical records or unverified reports.

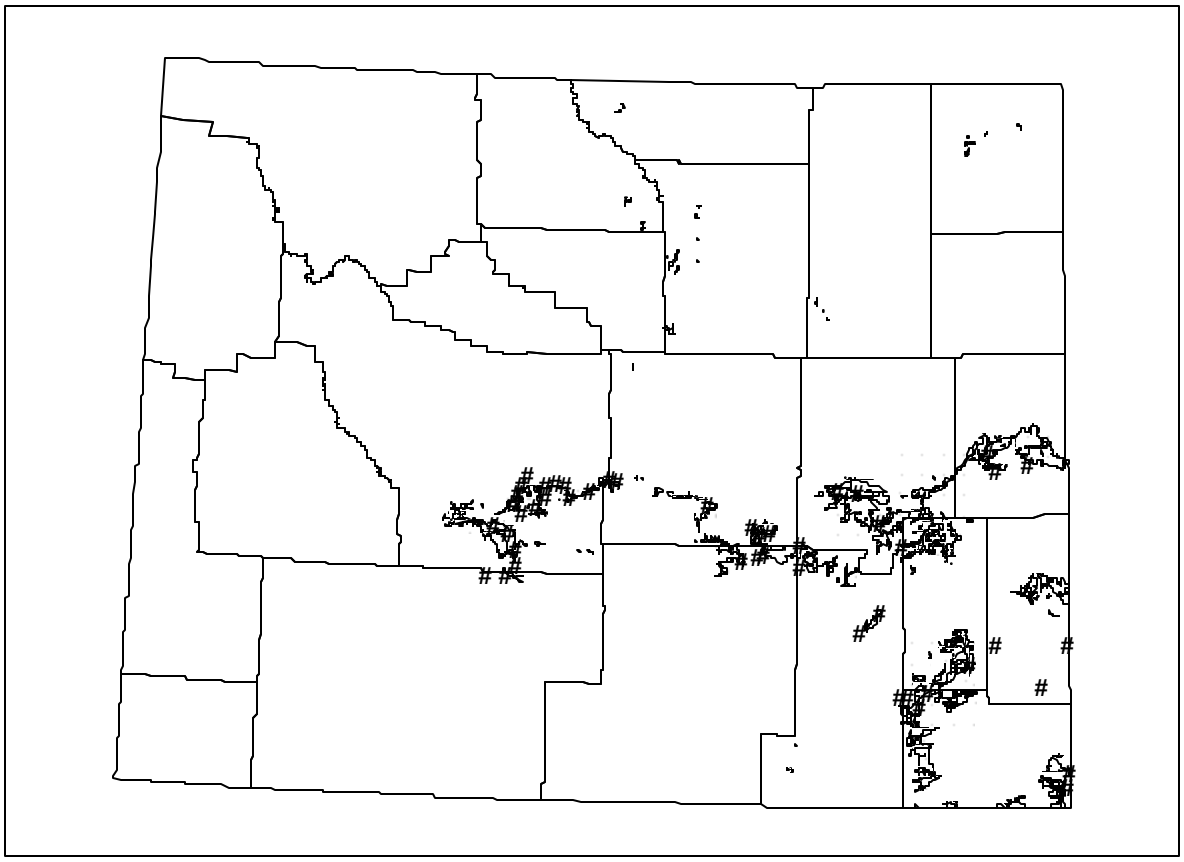
Figure 6. Location of the *Yermo xanthocephalus* population (element occurrence #001) – sensitive data

Extent of Surveys in Wyoming: Surveys from 1990 to 1993 failed to uncover additional occurrences of *Yermo xanthocephalus* (R. Dorn and R. Scott, personal communications to Walter Fertig). Expanded surveys were conducted in 1994 that focused on outcrops of the Split Rock, White River, Wagon Bed, and Wind River formations east-west along east-west-trending Cedar Rim and Beaver Rim in southern Fremont County, Wyoming (Fertig 1995). These surveys covered the north-south area from the north bank of the Sweetwater River north to Oil Mountain and Sand Draw. No new

populations were located in these areas. In 1997, Walter Fertig and Laura Welp conducted follow-up surveys along much of the remaining length of Beaver Rim in Fremont and Natrona counties and in the Shirley Basin in Carbon County.

Surveys in 2001 focused on segments of Cedar Rim and Beaver Rim areas and surrounding areas near the known population that were not addressed in 1994 or 1997. Priority was placed on visiting areas of the most extensive outcrops of the "White River Formation" (Miocene volcanic ash deposits) throughout the state, including places in the Shirley Basin, the foothills of the Laramie Range, Pine Bluffs, Hat Creek Breaks, and many other smaller escarpments, ridgelines, and buttes (Figure 7). In areas where Miocene outcrops they were extensive, a wide range of topographic positions were surveyed. Each of the 48 points on the 2001 survey map (Figure 7) represents one or more surveys in a section or contiguous sections.

Figure 7. Miocene volcanic ash deposits in Wyoming and *Yermo xanthocephalus* surveys (2001)



The 2001 survey did not produce any new information to support the model of species' potential distribution as indicated by geology. Additions were made to the 1994 and 1997 set of survey route maps to document more areas surveyed along the Beaver and Cedar Rims (Appendix B), and recommend that these surveyed areas be ruled out from consideration as potential occupied habitat. Available information and the results of this survey indicate that this model of species' potential distribution based on Miocene ash deposits is not appropriate to consider in identifying potential habitat and potential impacts for the species.

The current and original characterization of species' location is highlighted in Table 1.

Table 1. Location of the population of *Yermo xanthocephalus* in central Wyoming (from Fertig 1995).

County: Fremont. -Sensitive data-

Habitat: *Yermo xanthocephalus* occurs in sparsely-vegetated cushion plant communities with scattered clumps of Indian ricegrass (*Oryzopsis hymenoides*). The following habitat characterization was developed by Fertig (1995) unless otherwise stated. Vegetation cover is low, often less than 10%. The vegetation is an early successional or disclimax plant community that may be maintained by erosion and microhabitat conditions.

Characteristic cushion plant species that may be locally common include Hooker's sandwort (*Arenaria hookeri*), thistle milkvetch (*Astragalus kentrophyta*), stemless hymenoxy (*Hymenoxys acaulis*), and squarestem phlox (*Phlox muscoides*). There are signs of plant burial and accelerated erosion in unvegetated areas, particularly noticeable around the low-growing cushion plants, which have little or no litter accumulation.

Yermo xanthocephalus is absent from comparatively well-vegetated surrounding areas dominated by Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*), bluebunch wheatgrass (*Elymus spicatus*) and needle-and-thread (*Stipa comata*). A list of the frequently associated species includes:

Arenaria hookeri (Hooker's sandwort)
Astragalus kentrophyta (thistle milkvetch)
Cirsium aridum (Cedar Rim thistle)
Cryptantha caespitosa (caespitose cat's-eye)
Eriogonum brevicaule var. *micranthum* (shortstem wild buckwheat)
Eriogonum ovalifolium var. *purpureum* (cushion wild buckwheat)
Haplopappus armerioides (thrift goldenweed)
Haplopappus nuttallii (Nuttall's goldenweed)
Hymenoxys acaulis (stemless hymenoxys)
Ivesia gordonii (Gordon's ivesia)
Linum lewisii (blue flax)
Lomatium nuttallii (Nuttall's biscuitroot)
Lupinus argenteus (silvery lupine)
Oryzopsis contracta (contracted Indian ricegrass)
Oryzopsis hymenoides (Indian ricegrass)
Penstemon paysoniorum (Payson's beardtongue)
Phlox muscoides (squarestem phlox)
Phlox pungens (Beaver Rim phlox)
Physaria eburniflora (Devil's Gate twinpod)
Senecio canus (woolly groundsel)
Thermopsis rhombifolia (round-leaved goldenpea)
Townsendia spathulata (sword-leaf Easter-daisy)

In this and adjoining habitats, four additional state or regional endemics are present, including: Cedar Rim thistle (*Cirsium aridum*), Devil's Gate twinpod (*Physaria eburnifolia*), Beaver Rim phlox (*Phlox pungens*), and contracted Indian rice-grass (*Oryzopsis contracta*. The latter species has been documented as more common than previously known.

Yermo xanthocephalus occurs on low slopes, rim margins, colluvial fans, and bottoms within deflation hollows (Figures 8-10). These hollows have developed on sites lacking an erosional lag surface (desert pavement) and with low vegetation cover exposed to strong winds (Bynum 1993). The shape and orientation of the hollows allow wind-blown snow to accumulate, providing additional moisture in this desert region. The largest of the three subpopulations is in a large hollow at the base of a south-facing bluff. The smaller subpopulations have eastern and northeastern aspects. *Yermo xanthocephalus* was not found at other sites in the Beaver Rim with favorable substrates that lacked the appropriate topographic features and relief. The elevation of known *Yermo xanthocephalus* habitat ranges from 6720 to 6760 feet (2050-2060 m).

Yermo xanthocephalus appears to be restricted to recent soils derived from sandstones and limestones of the Split Rock Formation at its junction with the White River Formation. The species grows in shallow, loamy soils of the Entisol order that can be classified as a coarse-loamy over sandy-skeletal, mixed, Lithic Torriorthent (Bynum 1993). These soils contrast with the deep, sandy-loam aridisols occupied by adjacent Wyoming big sagebrush grassland communities (Figure 11).

Soils that support *Yermo xanthocephalus* are likely to be of recent origin due to the lack of subsurface horizons (profile development). The surface stratum has little organic matter and subsurface layers show no accumulation of humus, clay, gypsum, salts, or carbonates. The weak soil development at these sites is probably the result of limited moisture, frigid soil temperatures, and landscape instability caused by wind erosion (Bynum 1993). These soils can be extremely dry and brick-like in consistency in late summer, but are moist below the surface in the spring (Richard Scott personal communication to Walter Fertig). Soils are mildly alkaline (pH 7.5), and slightly calcareous at the surface from wind-blown carbonates, while the parent materials are non-calcareous (Bynum 1993). Conductivity and water-holding capacity have not been reported.

Soils on the south end of Cedar Rim are derived from outcrops of the Miocene-age Split Rock Formation (Love 1961; Van Houten 1964). This formation is composed primarily of porous, fine to coarse textured, whitish or tan sandstones and clays. The Split Rock Formation forms a persistent cliff at the top of Beaver Rim, but is mostly buried elsewhere in the Sweetwater Plateau (Van Houten 1964). *Yermo xanthocephalus* has not been documented on similar Tertiary sandstone outcrops of the lower White River, Wagon Bed, or Wind River formations in the Beaver Rim area.

Yermo xanthocephalus grows in shallow, loamy soils of the Entisol order and can be classified as a coarse-loamy over sandy-skeletal, mixed, Lithic Torriorthent. These soils contrast with the deep, sandy-loam aridisols occupied by adjacent Wyoming big sagebrush grassland communities (Bynum 1993).

Figure 8. Position of *Yermo xanthocephalus* on the landscape.
The species is restricted to low slopes, rims, and colluvial fans in deflation hollows. It is absent from areas within these depressions that are slightly elevated and dominated by high cover of big sagebrush,

Junegrass, and bluebunch cheatgrass. *Illustration by Walter Fertig*

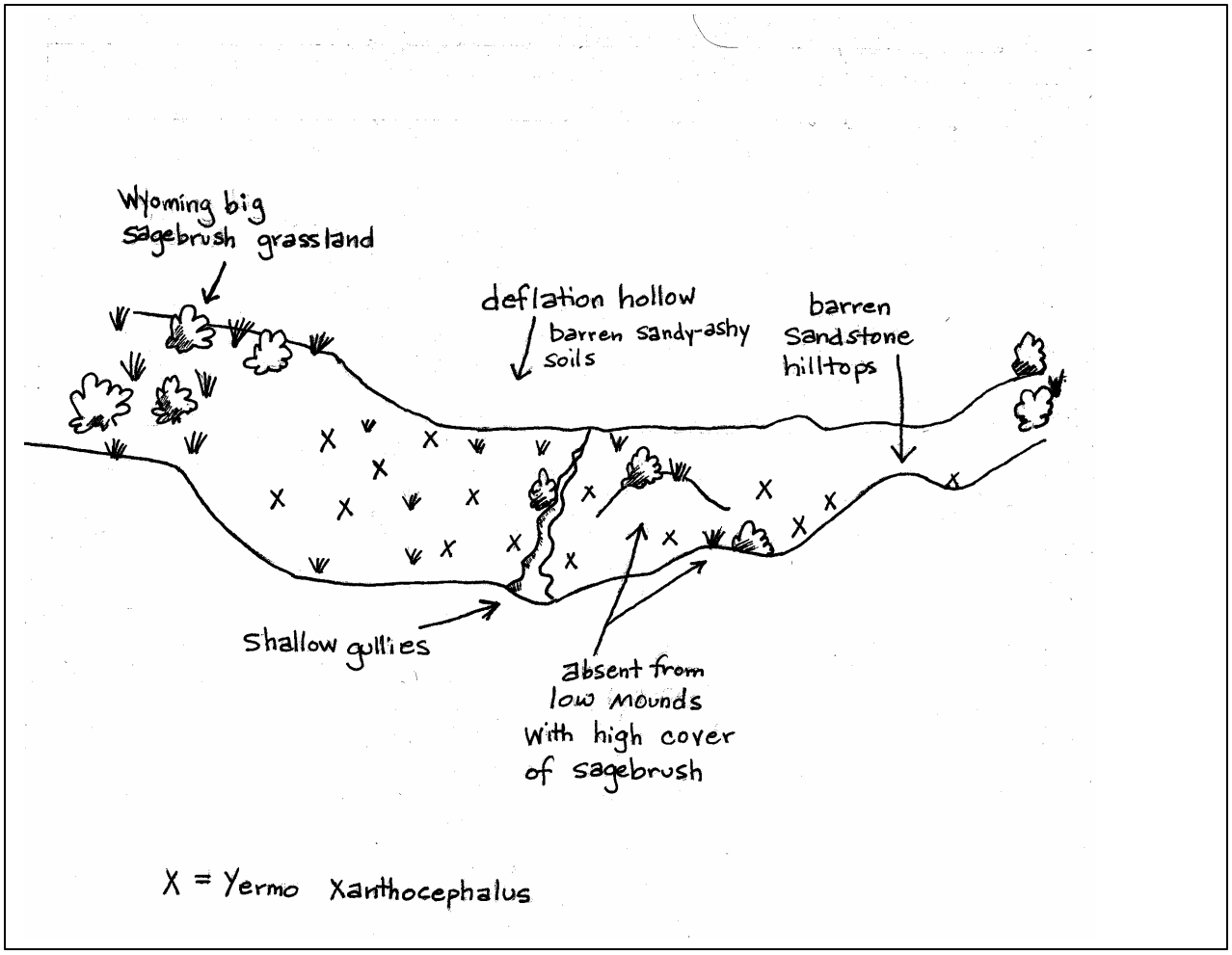


Figure 9. Habitat of *Yermo xanthocephalus*. Note: Sparse vegetation and colluvial fan
Photo by Charmaine Refsdal

- Sensitive data-

Figure 10. Beaver Rim outcrop and deflation hollows. View from second subpopulation toward base of bluff and largest subpopulation. *Photo by Walter Fertig*

-Sensitive data-

Figure 11. Landscape setting of *Yermo xanthocephalus* microhabitat. Note: The largest subpopulation is at the base of the bluff. Another is on a portion of the knoll to the left.
Photo by Bonnie Heidel

A climate station was maintained at Sand Draw (1948-1977), approximately 9 air miles north of the *Yermo xanthocephalus* occurrence at the south end of Cedar Rim. Average annual precipitation in the Cedar Rim area is 10 inches (254 mm), with peak levels from April to June. Mean annual temperature is 44° F (6.7° C), with mean maximum and minimum temperatures in January of 34° and 10° F (1.1° and - 12.2° C) and mean maximum and minimum temperatures in July of 86° and 54° F (30° and 12.2° C) (Martner 1986). Monthly mean temperature and precipitation data from this station are summarized in Table 2 (Martner 1986). Cedar Rim is approximately 800 feet higher than the Sand Draw climate station and is thus cooler and has higher precipitation. The bowl-like topographic relief of the *Yermo xanthocephalus* habitat accumulates run-off from the terrain above and captures wind-drifted snow under some wind conditions, making these sites more mesic than precipitation data alone might predict.

In 1994, Dr. Richard Scott of Central Wyoming College established a climate station at the south end of Cedar Rim specifically to record local climate data for the population of *Yermo xanthocephalus* and other rare plants at this site. This climate station is gathering hourly data on precipitation, air temperature, soil temperature (at depths of 10 and 20 cm), relative humidity, wind speed, wind direction, and solar radiation. This data offer opportunities to correlate germination episodes and flowering levels with climatic variables, and possible correlate population trends with climatic variables (Richard Scott personal communication to Bonnie Heidel).

Table 2.

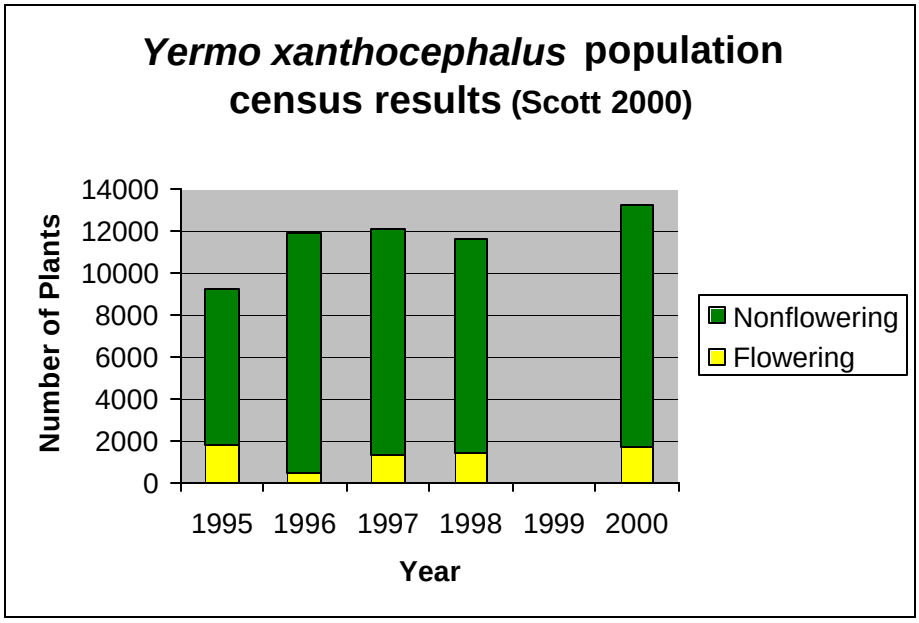
Summary of Monthly Climate Data, Sand Draw, Wyoming
Elevation 5960 ft (1820 m), 1951-1977 (from Martner 1986)

Month	**Mean Temperature °F (°C)**	**Average Precipitation inches (mm)**
January	22.9 (- 5.1)	0.23 (5.8)
February	26.7 (- 2.9)	0.38 (9.6)
March	31.2 (- 0.4)	0.51 (13.0)
April	41.2 (5.1)	1.55 (39.4)
May	52.3 (11.3)	1.89 (48.0)
June	61.9 (16.6)	1.59 (40.4)
July	70.5 (21.4)	0.67 (17.0)
August	69.0 (20.5)	0.60 (15.2)
September	58.0 (14.4)	0.70 (17.8)
October	47.3 (8.5)	0.76 (19.3)
November	32.8 (0.4)	0.42 (10.6)
December	25.4 (-3.6)	0.36 (9.1)
Mean Annual	44.9 (7.2)	9.66 (245.4)
Mean April-Sept.	58.8 (14.9)	7.00 (177.8)

Population Size and Trends: Only one population of *Yermo xanthocephalus* is known. The outer margin of the population marks an area of 42.5 ac (17 ha) but the actual area that supports plants is 8.33 ac (3.27 ha; Scott 2000). It lies along the south end of Cedar Rim in southern Fremont County, Wyoming. This population consists of one large subpopulation at the base of Cedar Rim and two smaller satellite subpopulations associated with low sandstone and conglomerate hills less than 0.25 miles to the south and southeast.

Dorn (1991) estimated the total population of *Y. xanthocephalus* at approximately 500 plants in 1990, a visual estimate of one subpopulation. Surveys in 1993 and 1994 suggested that the population was slightly larger, approaching 1500 individuals (Fertig 1955), based on visual estimates in all three subpopulations. It is difficult to get an accurate visual estimate that includes both flowering and nonflowering plants because the flowering plants are much more conspicuous, and the ratios between flowering and nonflowering plants differ across the population. Exhaustive population censuses have been conducted by Richard and Beverly Scott since 1995, documenting peak numbers of 13,244 plants in 2000 (11,927 plants in 2001; Scott 2000, USDI FWS 2002). Estimates cannot be directly compared with exhaustive counts to determine the magnitude of change because they are preliminary. The 7-year trend documented through population census indicates that there has been an app. 30% increase between 1995-2000 (taking minimum and maximum values, of 1995 and 2000, respectively). Population numbers did not change by more than 28% between consecutive years, an indication of relative population stability despite a harsh and changing environment.

Figure 12. *Yermo xanthocephalus* population results



A review of 1995-2000 population census results presented by Scott (2000) shows that flowering plants comprised 3.7-19.5% of the total plant numbers. The exceptionally low level of flowering (443 plants among 11,910 plants) occurred in 1996, which corresponded with a relatively dry year as indicated by NOAA records from Riverton.

Demographic data collected in 1994 (Fertig 1995) are summarized in Table 3.

Table 3. Demographic information for the population of *Yermo xanthocephalus* (Fertig 1995, with updates)

Occurrence # 001 (divided into 3 subpopulations)
Area: 8.33 acres (determined using GPS techniques; Scott 2000).
Number and age of plants: The population census values range from 9,293 in 1995 to 13,244 plants in 2000. The age of plants cannot be determined at any stage in the life cycle, though there are discrete stage classes that tend to correspond with age. Even the seedlings may retain cotyledons for two years. A 9-year monitoring of 50 plants had over half of the plants alive throughout this period (Richard Scott personal communication to Bonnie Heidel).
Density: The species is not evenly distributed across the landscape but patchy. Highest numbers are concentrated along colluvial fans. It is nowhere abundant, but as one of the more conspicuous plant species where it is found, it appears to be locally common in small areas.
Presence of dispersed seed: Mature achenes were observed on fruiting plants and on the ground surface below these plants in 1994. The plant's non-random, clumped distribution pattern suggests that dispersal distances are probably low.

Yermo xanthocephalus is a perennial that reproduces sexually by seed, and possibly by vegetative buds that separate from and survive the parent plant (Richard Scott personal communication to Bonnie Heidel). Each plant has 1-few rosettes, and none or many rosettes of the same plant may produce a flowering stalk in the same year. Each plant flowers more than once over its life cycle (iteroparity). Each flower produces 4-6 seeds, and the number of flowers per plant ranges from 25-180, for a total of 100-1080 seeds potentially produced per plant. Dorn (1991) originally hypothesized that total fruit production may be low due to heavy herbivory by insects and to drought-induced abortion. Monitoring so far suggests only minor herbivory impacts, though there may be high proportions of aborted seeds (Richard Scott personal communication to Connie Breckenridge). The perennating buds for producing new rosettes and flowering stems appear at the base of leaves.

Yermo xanthocephalus is probably pollinated by visually-oriented insects attracted to its bright yellow ray flowers and involucre bracts (Dorn 1991). It appears to be an obligate outcrosser, as observed from preliminary experiments in which flowers were bagged when in bud (Richard Scott personal communication to Bonnie Heidel). There have been several Hymenopterans collected on *Yermo* heads (Jerry Freilich personal communication to Richard Scott) and small skipper butterflies noted (Richard Scott personal communication to Walter Fertig). The identity of these prospective pollinators is not known at present.

The fruits of *Yermo xanthocephalus* are single-seeded achenes with a parachute-like pappus of slender bristles. At maturity, the involucre bracts spread laterally to expose the fruits to wind. Strong winds in the Beaver Rim area may disperse these fruits over long distances. The clumped distribution pattern of *Y. xanthocephalus*, however, suggests that dispersal distances are relatively short. The clustering of *Yermo* plants along colluvial washes further suggests that seed dispersal over short distances may be fostered by water erosion.

Yermo xanthocephalus is a classic "K" selected species characterized by a long-lived perennial growth form, adaptation to severe habitats (deep root system, leathery leaves, basal rosette growth form), and

limited annual reproductive output. The mean and maximum lifespan of the species is not known, but in a marked set of 50 plants followed for 9 years, more than half remained alive over the 9 year span (Richard Scott personal communication to Bonnie Heidel).

What are the minimum population viability requirements of the *Yermo* population? Minimum viable populations are often on the order of 1000-100,000 individuals according to Menges (1991); and at the lower end of this range for longer-lived organisms. He offers some generalizations that environmental fluctuation and natural catastrophes are the primary threats to most *in situ* plant populations that do not have immediate threats. To make the best use of population census data, it would be useful to correlate census results with climate variables to characterize "natural" trends. This analysis of data may also be useful for developing standards as to what would constitute a significant population decline between two or more consecutive years.

To understand the population trends, it is would also be useful to analyze results from the demographic monitoring of 50 plant individuals that has been conducted since 1992 and chronicle all other observations regarding the four major life cycle stages. Even if species "age classes" are not known, species "stage classes", their transition probabilities, and mortality levels are useful in determining population viability. These stage classes are described in following paragraphs.

The seedling stage is recognized in the field by the presence of a cotyledon. Seeds germinate in fall depending on moisture availability, and produce 1-2 leaves in their first growing season. However, plants may retain their cotyledons for a second year, so that not even the age of the seedlings can be determined except at the time of germination (Richard Scott personal communication to Bonnie Heidel).

Seed germination was studied in the laboratory using a collection of seeds from two growing seasons (1999 and 1998; Scott and Hoster 2000). They were submerged and aerated in distilled water, and set in a growth chamber with a 12-hr photoperiod with the light influencing water temperatures, such that water temperatures ranged from 16.4-21.9 C. There was no cold stratification or viability test using acetocholine. Three stages of seed development were documented:

Stage 1. Emergence of the radicle (1-9 days)
Stage 2. Development of the primary root and hooked curvature (10-20 days)
Stage 3. Appearance of green cotyledons (21+ days)

Significant numbers of the seeds (54% in 1998 and 45% in 1999) died in this treatment.

In typical years, germination of seedlings is probably extremely low or absent (Dorn 1991). Germination and establishment is probably episodic and dependent on suitable moisture conditions, and dependent on a natural seedbank. It takes at least 3 weeks for the cotyledons to emerge from the seed under laboratory conditions (Scott and Holster 2000).
Immature vegetative plants are the next stage. Information that is being gathered by Richard Scott may help determine the how long it takes seedlings to develop deep root systems and become established. He observes that many *Yermo* seedlings survive the winter but most die in a year or two (Richard Scott personal communication to Bonnie Heidel). More information is needed on root system development and water table conditions to characterize immature plants.

Third is the mature plant stage. Mature plants may be in either vegetative or flowering phase.

They have the lowest mortality levels. Burial in sheetwash erosion accounted for most apparent deaths (Richard Scott personal communication to Bonnie Heidel). Vegetative plants have been monitored for 3+ years without producing flowers (Richard Scott personal communication to Walter Fertig). The transition from vegetative to flowering life cycle changes is probably influenced by weather, as indicated by shifting ratios of flowering to vegetative plants from 1995-2000 (Scott 2000). It may also be influenced by the previous year's life history stage, e.g., if plants that flower one year may be less likely to flower the following year compared to vegetative plant. It is not known whether the apical bud for the flowering stem is set in fall or spring. The number of years required for seedlings to produce flowering stems is not known.

Fourth is a likely seedbank stage, a "cryptic" stage involving dormant seeds that persist below ground for more than one year. Seeds of *Yermo* have been stored under refrigeration for 8 years and remained viable (Richard Scott personal communication to Bonnie Heidel).Typically, species that produce seedbanks have a fraction that germinates and a fraction that retains dormancy. Both sets are viable but the latter has a mechanical or chemical inhibition. Seedbank longevity differs by species, as well as the respective dormancy-breaking mechanisms. Seedbanks are considered adaptations for fluctuating environments (Rees 1994).

At this time, we do not have the information to determine which life history stage and mortality factor ("bottlenecks") are most important in maintaining the current trend of increasing population numbers. Analysis of census data, correlation between census and climate data, and synthesis of all available life history information will support hypothesis and set the course for any contingency plans in event of population decline.

Current Management: The prevailing land use is cattle grazing in and around the habitat of *Yermo xanthocephalus*. The population lies in the Big Pasture grazing allotment and the Dishpan Wild Horse Heard Area (Breckenridge 2000). The entire known range of *Yermo xanthocephalus* occurs on lands managed by the Lander Resource Area of the Bureau of Land Management (BLM) Rawlins District. No populations are found on state or private lands.

The nearest streambed is Government Creek, but it is ephemeral. The only season-long water source in the allotment is about 2.5 mi (4 km) away. Livestock, horses and antelope are not known to graze the plant. The few observations that a plant had been grazed or browsed indicated that the plant was not ingested but discarded nearby. Due to low forage availability and the lack of water, livestock utilization of *Yermo* habitat is limited. They appear to utilize *Yermo xanthocephalus* habitat as they casually move along "cow trails" and a 2-track road as travel corridors between adjacent sagebrush-grassland pastures. Individual *Yermo* plants and transect markers have been observed to be trampled or dislodged, presumably by livestock, horses or antelope (these plants and markers were located far from vehicle routes). Trampling may be a very low existing threat to the plant, or a potentially greater threat if range management changed.
Provisions for maintaining the current range management regime were outlined in the draft BLM conservation strategy (Breckenridge 2000). It was proposed that no mineral supplements will be placed within two miles of the *Yermo* site, no additional water sources will be developed in this same distance, no supplemental feed will be used in the allotment without written approval, and any supplemental feed or bedding must be certified weedfree, and livestock will not be intentionally herded or trailed through the site.

The area had been explored for oil and gas and an exploratory well was drilled in 1952 that lies 0.33 miles (0.5 km) to the north of the population (Figure 6; Breckenridge 2000). It was a dry hole that was

plugged and abandoned in 1953. As part of this exploration, an access route from the southwest was bulldozed; a route that is currently closed off.

Existing and Potential Threats: Low population size and a small geographic range make *Yermo xanthocephalus* extremely vulnerable to extinction from habitat degradation, habitat loss, and chance natural events. The existing and potential threats to the species are compiled and described in greater detail in the draft conservation assessment (Breckenridge 2000), and in the determination that *Yermo* is threatened (USDI FWS 2002).

Oil and gas exploration in the Beaver Rim area is a potential threat to *Yermo xanthocephalus* habitat. In 1996 and 1997, two 10-year gas leases were issued without stipulation by BLM that encompass or adjoin the occupied habitat. Applications for four permits to drill were filed that same year, and two were permitted in 1998 by BLM on pre-existing wellpads. The other two were later permitted with the addition of mitigating measures that address timing and a weed control plan (Breckenridge 2000).

Even in the exploratory phase of oil and gas development, construction of access roads, well pads and seismic activity in or near occupied habitat are potential threats due to mechanical damage to individual plants by vehicles, soil compaction, erosion, and possible introduction of noxious weeds. In the event that oil and gas wells are developed, then pipeline construction, facilities construction, increased traffic, and all of the associated potential affects ensue.

In addition to oil and gas development, exploratory coalbed methane drilling is taking place elsewhere in the county, though the local potential is unknown. There are also onsite uranium mining stakes but they have been abandoned, and there are onsite zeolite stakes but they are for resources that are at depths making them unprofitable in today's market (Breckenridge 2000). In 1999, BLM filed an application to withdraw the *Yermo* site and a buffer around it from mineral sales and entry under the General Mining Act (USDI 1999; cited in Breckenridge 2000). A Decision Record was not issued within two years, canceling the application. The recognition that this species is potentially threatened by oil and gas or mining was cited in the recent determination that the species is threatened (USDI FWS 2002).

Road and off-road use of motorized vehicles for recreation is an existing and potential threat to *Yermo xanthocephalus* through mechanical damage to plants, soil erosion, and noxious weed introduction. The 2-track route to the site approaches it from the northwest and crosses part of the population. It does not connect with other roads in current road system conditions. There appears to be the most traffic into this area during antelope season, albeit light (Richard Scott personal communication to Bonnie Heidel). The threat from vehicle trampling and erosion is greatest in spring and summer when plants are in flower or heavy with developing fruit, but. road and off-road recreation use could potentially become an avenue for noxious weed introduction any time of year. There are no physical barriers to prevent vehicle access to the three subpopulations of *Y. xanthocephalus*. Species' response to simulated vehicle and livestock damage (and fire) are planned for 2002 (Richard Scott personal communication to Bonnie Heidel).

Due to its small range and low numbers, *Yermo xanthocephalus* is vulnerable to extinction through chance environmental catastrophes. It has not shown a decline under the drought conditions of the past year (Richard Scott personal communication to Bonnie Heidel). Existing census and monitoring data should be analyzed to identify other climate conditions or events that may be directly adverse to the *Yermo xanthocephalus* population. The absence of competing vegetation suggests that *Y.*

xanthocephalus may be intolerant of competition and affected by succession, although it is equally plausible that other species are poorly adapted to these microhabitats. The quantitative and qualitative extent of habitat over time needs to be considered as it may indirectly affect the population.

Incidental to studies and agency actions, it has been featured in newspapers, the *Castilleja* newsletter of Wyoming Native Plant Society, and in a Science News article (Milius 1999). It was also featured on the cover of the Science News issue, and presented in the article as an example of the opportunity and ongoing need for research in identifying plant species unknown to science. However, this same article included inference that species new to science may be discovered "…in backyards," which can be misinterpreted to mean that such species are not specialized or could be found with casual inventory effort in many areas including modified landscapes. This species is included within the WYNDD sensitive data policy because of its highly restricted distribution and its threatened status. Likewise, the BLM had proposed that the population site not be featured in any public information (Breckenridge 2000). The species could be threatened by vandalism and unauthorized collection (USDI FWS 1998).

A small set of seeds has been collected to archive in the Nebraska Statewide Arboretum. The 1997 collection was comprised of about 100 achenes, collected by Jim Locklear. Germination experiments have been conducted (Scott and Hoster 2000). Small trial transplant experiments have been unsuccessful to date (Scott 2000). These tasks set the stage for propagation and transplanting techniques that are in early stages of development and offer stopgap measures.

Potential threats to *Yermo* are regularly reviewed in some measure as part of research and annual census visits. This review is informally discussed and chronicled among researchers and agencies but might be standardized. A contingency plan is needed if there are new threats, or if the census results document significant decline (defined by some threshold condition).

SUMMARY

Yermo xanthocephalus is a recently described Wyoming endemic known only from the south end of Cedar Rim on the summit of Beaver Rim in southern Fremont County. It is the only species in the genus, and different from most members of the large Aster Family in having yellow involucral bracts. It is known from a single population occupying an area of 8.33 acres of suitable habitat. This population consists of three subpopulations with peak numbers of 13,244 plants in the past 7 years. The species is restricted to shallow deflation hollows in outcrops of Miocene sandstones and limestones of the Split Rock Formation. These wind-excavated hollows are more mesic than surrounding areas. However, the vegetation of these sites is typically sparse, consisting primarily of low cushion plants and scattered clumps of Indian ricegrass. Surveys in 1990-93, 1994, 1997, and 2001 have failed to locate additional populations on outcrops of the similar White River, Wagon Bed, and Wind River formations in the Beaver Rim area. The existing population is potentially threatened by surface disturbances associated with oil and gas development, damage by vehicles and livestock trampling, and chance natural events. On March 14, 2002 it was determined to be threatened under the Endangered Species Act (USDI FWS 2002), which takes effect April 15, 2002.

One of the tasks identified in the draft *Yermo xanthocephalus* conservation strategy was to "Establish and conduct monitoring, biological, ecological and life history studies for the species" (Breckenridge 2000). This report provides a summary of existing available information. As cited in the report, there are key datasets, data analyses, and compilation of observations that are missing.

We do not know:

- ? the relationship between climate and life history (germination events, flowering levels, and seed abortion levels).
- ? the relationship between climate and population trends.
- ? stage class transitions and mortality levels.
- ? primary pollinators and their habitat requirements.
- ? basic soil characteristics and local climate characteristics.
- ? dynamics of the vegetation in *Yermo* habitat as it relates to wind and water erosion.
- ? evolutionary origin of the species.

The highest priority is to compile and analyze existing available data that may shed light on *Yermo xanthocephalus*. Beyond that, a peer-reviewed research plan would ideally be developed to address the most pressing conservation biology information needs and management concerns.

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