Status Report on

Mystery wormwood

(*Artemisia biennis* var. *diffusa*)

in Southwest Wyoming

Prepared for the Bureau of Land Management
Wyoming State Office

By

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Abstract

Artemisia biennis var. *diffusa* is known from a single population in a playa area north of Point of Rocks Wyoming. Since its initial discovery by Robert Dorn in 1980, no additional occurrences have been discovered, and the type population has not been relocated. Questions exist regarding the taxonomic distinctiveness of var. *diffusa*, which differs from the more widespread var. *biennis* in its low stature (under 30 cm high), short leaves, and multi-branched stems. In the absence of additional specimens, it remains to be determined if var. *diffusa* represents a distinct variety or merely an environmentally-induced variant of var. *biennis*. Surveys in 1998 failed to relocate the type population or other locations. Additional surveys are recommended, especially during late summer in wet years, before the taxon is officially considered extinct. Propagation studies, utilizing seed from the type specimen is recommended as a potential means of increasing population size and providing material for needed biosystematic studies.

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I. INTRODUCTION

In August 1980, Robert Dorn discovered an unusual population of Biennial wormwood (*Artemisia biennis*) on a clay flat north of Point of Rocks, Wyoming. The plants in this population differed from typical *A. biennis* in having atypically short leaves and multiple, short branches all originating from the base of the main stem. Dorn revisited the site at least four other years during the 1980s, but was unable to relocate these unusual plants. In 1988, Dorn described the Point of Rocks population as a new taxon, *Artemisia biennis* var. *diffusa* (Dorn 1988).

In the years since it was described, numerous other botanists have searched in vain for this plant, dubbed the "mystery wormwood". Due to its apparent rarity, var. *diffusa* was designated a Category 2 (C2) candidate for listing under the Endangered Species Act in 1993 (US Fish and Wildlife Service 1993) and is managed as a "Special Status" plant by the Bureau of Land Management (BLM) Rock Springs District (Amidon 1994). Questions have arisen in recent years about the authenticity of this taxon and whether it warrants special management attention. In 1998 the BLM Wyoming State Office contracted with the Wyoming Natural Diversity Database on a cost-share basis to conduct field surveys and evaluate the status of this taxon on BLM lands in southwestern Wyoming. The objective of this report is to summarize new and existing data on the biology, distribution, habitat, population size, and potential threats of *Artemisia biennis* var. *diffusa* to be used in determining its conservation status and management needs in Wyoming.

II. METHODS

Information on the habitat and distribution of *Artemisia biennis* var. *diffusa* was obtained from secondary sources, including WYNDD files and computer databases, specimens from the Rocky Mountain Herbarium (RM), scientific literature, and knowledgeable individuals. USGS topographic maps, geologic maps (Love and Christiansen 1985), and BLM land status maps were used to identify areas of potential habitat for ground survey. Field surveys were conducted by Laura Welp in late August 1998 (survey sites are indicated in Appendix A). Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

III. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: *Artemisia biennis* Willd. var. *diffusa* Dorn (Dorn, 1988). Type specimen: USA, Wyoming, Sweetwater County, T21N R101W Sec 25 S1/2. Clay flats and playas, 6500 ft., 22 August 1980, Dorn 3668 (RM).

2. SYNONYMS: None.

3. COMMON NAME: Mystery wormwood.

4. FAMILY: Asteraceae or Compositae (sunflower family).

5. SIZE OF GENUS: The genus *Artemisia* contains over 300 species in Eurasia, North America, western South America, and South Africa (Mabberly 1987). Over 100 species have been attributed to North America, although Cronquist (1994) recognizes less than 50 for the entire continent. Dorn (1992) lists 22 species of *Artemisia* in the flora of Wyoming (33 taxa when varieties are considered).

6. PHYLOGENETIC RELATIONSHIPS: *Artemisia biennis* var. *diffusa* is most closely related to *A. biennis* var. *biennis* from which it differs in branching habit, leaf size, and overall stature.

7. TAXONOMIC CONSIDERATIONS: Var. *diffusa* is based only on the 1980 holotype, consisting of two specimens from a total population estimated in the "hundreds" by Dorn. Although unusual in appearance, none of the morphological characters used to differentiate this taxon from var. *biennis* is unique. Several specimens of var. *biennis* from southern and central Wyoming at the RM have various combinations of multiple-branched stems, short leaves, or low stature (R. Williams 746; J. Haines 5433; R. Hartman 10444; W. Fertig 16760). It may be that the type specimen of var. *diffusa* represents a genetic or environmentally induced morphological extreme of *A. biennis* rather than a distinct taxonomic entity. Such a question can only be resolved by a thorough biosystematic study by a taxonomist who is familiar with the group, employing modern techniques for assessing relationships.

B. PRESENT LEGAL OR OTHER FORMAL STATUS:

1. NATIONAL

   a. LEGAL STATUS: *Artemisia biennis* var. *diffusa* was formerly a C2 candidate for listing under the Endangered Species Act (US Fish and Wildlife Service 1993). The C2 list included species that might have warranted listing as Threatened or Endangered, but for which the US Fish and Wildlife Service (USFWS) lacked sufficient biological data to support a listing proposal. In February 1996, the USFWS revised its candidate policy and eliminated the C2 designation (US Fish and Wildlife Service 1996). *A. biennis* var. *diffusa* currently is listed as a "Special Status" plant by the BLM Rock Springs District (Amidon, 1994) but otherwise has no legal protection status.

b. HERITAGE RANK: *Artemisia biennis* var. *diffusa* is ranked G5T1Q in The Nature Conservancy's Natural Heritage network system. This rank indicates that the full species *A. biennis* is demonstrably secure worldwide, but that var. *diffusa* is considered "critically imperiled" throughout its range. Taxa ranked T1 typically have small population sizes or are known from 5 or fewer extant occurrences (Fertig 1997). A "Q" indicates there are questions about the taxonomic status of the plant.

2. STATE

a. LEGAL STATUS: None.

b. HERITAGE RANK: *Artemisia biennis* var. *diffusa* is ranked S1, indicating that it is critically imperiled because of extreme rarity in the state of Wyoming (Fertig 1997).

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: Mystery wormwood (Figure 1) is a glabrous or slightly hairy, non-odorous taprooted, annual or biennial herb with multiple stems, each up to 30 cm high, originating from the base of the main stem. The stem leaves are mostly 8 to 17 (26) mm long and once or twice pinnately divided into sharp-toothed segments. The dense, leafy, spike-like inflorescence is glabrous to moderately hairy and consists of numerous small greenish to yellowish flower heads. The receptacle and fruits are glabrous. Seedling or first year plants consist of a stemless basal rosette of once or twice pinnatifid leaves (Dorn 1988, 1992; Fertig *et al.* 1994).

2. TECHNICAL DESCRIPTION: Plants coarse, multi-stemmed annual or biennial herbs with tap-root, glabrous-to-slightly hairy and inodorous; stems erect, to 30 cm high; basal leaves early-deciduous, often withered by anthesis; cauline leaves 8–26 mm (avg. 10 mm), once or twice pinnate, the segments oblong to oblanceolate and sharply toothed; heads in spicate panicles, numerous and crowded, glabrous to moderately hairy, sessile or subsessile, erect or nearly so; involucres glabrous, 2-3 mm high, the bracts greenish to yellowish, the margins hyaline; flowers numerous, all potentially fertile, the outer 6-20 pistillate, the central 15-40 perfect; achenes smooth and shining, inconspicuously several-nerved, somewhat compressed, broadly oblanceolate, somewhat falcate and oblique at the summit (Barkley 1986; Cronquist 1994; Dorn 1988; Fertig *et al.* 1994; Welsh *et al*. 1993).

3. LOCAL FIELD CHARACTERISTICS: Mystery wormwood can be

recognized by its low stature, multi-stemmed habit, once-or-twice

Figure 1. Line drawing of *Artemisia biennis* var. *diffusa* by Isobel Nichols (Fertig *et al.* 1994).

divided leaves with sharp-pointed segments, narrow inflorescence with numerous, small, green-to-yellow heads, lack of odor, and lack of significant amounts of hair on the main stems and leaves.

4. SIMILAR SPECIES: *Artemisia biennis* var. *biennis* differs from var. *diffusa* in having longer leaves and a single main stem that usually exceeds 30 cm in height. *A. annua* is an introduced annual with a more open inflorescence of stalked heads. *A. campestris* has linear, pubescent leaves and a longer, more open inflorescence (Dorn 1992; Fertig *et al.* 1994).

D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Mystery wormwood is endemic to the Rock Springs Uplift area of north-central Sweetwater County, Wyoming (Figure 2). The entire known area occupied by the taxon is less than 5 acres.

2. EXTANT SITES: Mystery wormwood is known only from the type locality north of Point of Rocks and the Jim Bridger Power Plant (Figure 3, Table 1). This population has not been observed since 1980, despite at least eight visits by trained botanists in the last two decades. Laura Welp visited this site in August 1998, but was unable to locate either variety of *A. biennis*. Unless it is surviving in a seedbank, var. *diffusa* may be extirpated at this site.

3. UNVERIFIED/UNDOCUMENTED REPORTS: Laura Welp collected several first-year vegetative rosettes of *A. biennis* with small leaf segments at a dry playa south of the Honeycomb Buttes in 1998 that may represent this taxon. The site (T25N R99W S8 NW4) should be resurveyed in late summer of 1999 to determine which variety is present. No other reports of var. *diffusa* are currently known in Wyoming.

4. AREAS SURVEYED BUT TAXON NOT LOCATED: In 1998, potential habitat was unsuccessfully surveyed in North and South Baxter Basin, the Red Desert Basin, Deadman Wash and Ninemile Wash, Horsethief Canyon, Bear Creek, Alkali Creek, Cronin Draw, Bush Creek, Muddy Creek, South Barrel Spring Draw, Windmill Draw, Kinney Creek, Shell Creek, Salt Wells Creek, Black Butte Creek, Echo Springs Draw, Eightmile Lake, Stewart Creek, Chain Lakes Flat, Murphee Creek, Sand Springs Creek, and below and west of Adobe Town Rim (Appendix A). Previous surveys of ephemeral desert streams in the southern Overthrust Belt by Fertig in 1996 and floristic surveys by University of Wyoming graduate students in southwest Wyoming (1994-1997) have also failed to document new locations for this taxon (Cramer 1997; Delmatier 1998; Ward *et al.* 1998; Welp 1997).

Figure 2.

Figure3.

Table 1. Location Information for Known Populations of *Artemisia biennis* var. *diffusa* in
Southwestern Wyoming.

Occurrence #: 001.
County: Sweetwater.
Legal Description: T21N R101W S25 S1/2.
Latitude: 41° 45' 45" N.
Longitude: 108° 47' 14" W.
Elevation: 6500 ft. (1980 m).
USGS 7.5' Quad: Black Rock South.
Location: "Clay flat off Deadman Wash at north end of "The Meadows" [Playa on west side of Potash Wash Road, ca 0.5 miles west of the confluence of Ninemile and Deadman washes, ca 5.5 air miles north of Interstate 80 at Point of Rocks, and ca 1.5-2 air miles north of the Jim Bridger Power Plant].

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5. AREAS OF UNSURVEYED POTENTIAL HABITAT: Additional potential habitat may exist in playa areas of the Rock Springs Uplift and Green River or Washakie basins in southwest Wyoming. This species may be ephemeral, occurring in suitable habitats only after an unusually wet Spring. Repeat visits to potential sites (even those without plants in previous years) may be justified.

E. HABITAT

1. ASSOCIATED VEGETATION AND SPECIES: *Artemisia biennis* var. *diffusa* occurs on clay flats and playas dominated by foxtail barley (*Hordeum jubatum*), oak-leaf goosefoot (*Chenopodium glaucum*), spreading yellowcress (*Rorippa sinuata*), and kochia (*Kochia scoparia)* surrounded by scattered thickets of greasewood (*Sarcobatus vermiculatus*) and basin big sagebrush (*Artemisia tridentata* var. *tridentata*) (Figure 4).

2. TOPOGRAPHY: *Artemisia biennis* var. *diffusa* occurs in a broad valley surrounded by low ridges. The single known population occurs at 6500 feet (1980 m).

Figure 4. (page 13). Habitat of *Artemisia biennis* var. *diffusa* at the type locality near the confluence of Deadman Wash and Ninemile Wash. Playa habitat is dominated by *Hordeum jubatum* and surrounded by scattered *Sarcobatus vermiculatus* and *Artemisia tridentata*. WYNDD photograph by Laura Welp, August 1998.

3. SOIL RELATIONSHIPS: The single population of *Artemisia biennis* var. *diffusa* is found on fine-textured grayish-white alkaline clays derived from the Upper Cretaceous Lewis Shale (Love and Christiansen 1985). These soils are probably salt-affected aridisols. The surrounding uplands are composed of the Cretaceous Fox Hills Sandstone (Love and Christiansen 1985).

4. REGIONAL CLIMATE: Average annual precipitation within the range of *Artemisia biennis* var. *diffusa* is 8-10 inches (20-25 cm), with peak levels from April to June. Mean annual temperature is 42° F (5.5° C), with mean maximum and minimum temperatures in January of 29° and 8° F (- 1.6° and - 13.3° C) and mean maximum and minimum temperatures in July of 84° and 50° F (28.9° and 10° C) (Martner 1986).

5. LOCAL MICROCLIMATE: *Artemisia biennis* var. *diffusa* populations occur on fine-textured alkaline clay soils that are seasonally moist, but become dry and cracked in late summer.

F. POPULATION BIOLOGY AND DEMOGRAPHY

1. PHENOLOGY: Flowering and fruiting occurs primarily from late August through September.

2. POPULATION SIZE AND CONDITION: Dorn reported "hundreds of plants . . . all with the same growth form" from the type locality in August, 1980 (note on holotype label at RM). Nothing is known of the density or population structure of this occurrence, although Dorn's note infers that all plants were multi-branched second year individuals. All of the specimens from the type collection are in flower or fruit. Demographic information from the type location is summarized in Table 2.

   Despite numerous attempts, the type population has not been relocated since 1980 and may not be extant. It is possible that the population is surviving in the local seed bank and these seeds have not been able to germinate due to unfavorable environmental conditions. No other populations of *A. biennis* var. *diffusa* have been positively identified.

3. REPRODUCTIVE BIOLOGY

   a. TYPE OF REPRODUCTION: *Artemisia biennis* var. *diffusa* is thought to reproduce entirely by seed. Whether these seeds are produced by ordinary sexual means or by apomixis is not known, nor is it known whether fruits are viable. Germination studies, utilizing fruits from the type specimen, would help answer many of the taxonomic and life history questions regarding this taxon.

Table 2. Demographic Information for Known Populations of *Artemisia biennis* var. *diffusa* in Southwestern Wyoming.

Occurrence # 001
Area: Less than 5 acres.
Number and Age of Plants: "Hundreds of plants" reported by Robert Dorn in 1980.
Density: Not known.
Evidence of Reproduction: Plants observed in flower and fruit in 1980.
Evidence of Expansion/Contraction: Population has not been relocated since 1980, despite at least 8 return visits by trained botanists. The most recent re-survey attempt was in August 1998. This taxon may be extirpated at this site.

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b. POLLINATION BIOLOGY: The specific pollinator of *Artemisia biennis* var. *diffusa* is not known, although wind may be the primary agent.

c. SEED DISPERSAL AND BIOLOGY: Achenes of *Artemisia biennis* var. *diffusa* are somewhat compressed and lack a pappus or other structural features to facilitate long-distance dispersal. The germination requirements of this taxon are not known, although Dorn has suggested that "it must require very exact moisture conditions to germinate" (holotype specimen label at RM).

G. POPULATION ECOLOGY

1. GENERAL SUMMARY: The single known population of *Artemisia biennis* var. *diffusa* was found on whitish clay-shale soils of a dry playa. This population consisted of hundreds of individuals when it was last observed in 1980. Subsequent surveys have failed to relocate any individuals at the type locality or at any other sites. Nothing is known of the pollination, germination, or other basic life history attributes of this taxon, although Dorn has suggested that it may have very exacting germination requirements. Var. *diffusa* may represent an unusual genetic or environmentally based variant of *A. biennis* or is a possibly extirpated distinct taxon.

2. COMPETITION: *Artemisia biennis* is a somewhat weedy species that typically occurs in waste places or streambanks (Cronquist 1994). It would appear to be well adapted to areas of disturbed soil or competition from early successional species. The habitat of var. *diffusa* has relatively

sparse vegetation, dominated by *Hordeum*. According to Dorn (personal communication), the vegetation composition of the type locality has not changed markedly since 1980, ruling out succession and competition as the chief factor in the local disappearance of this species.

3. HERBIVORY: The type specimen of *Artemisia biennis* var. *diffusa* shows little physical evidence of herbivory by livestock, rodents, insects, or other potential grazers.

4. HYBRIDIZATION: It is not known whether *Artemisia biennis* var. *diffusa* is capable of hybridizing with other wormwood or sagebrush species. Genetic studies of var. *diffusa* plants raised from seed from the type specimen would be beneficial in determining if this taxon is potentially interfertile with related species or is itself of hybrid origin.

H. LAND OWNERSHIP: The single known population of *Artemisia biennis* var. *diffusa* is found on private lands within the BLM checkerboard managed by the Rock Springs District. This population is located within the industrial park of the Jim Bridger Power Plant in the vicinity of roads and settling ponds.

IV. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

A. POTENTIAL THREATS TO CURRENTLY KNOWN POPULATIONS: A small geographic range and specialized habitat makes this taxon vulnerable to large scale natural and human induced disturbances. The following potential threats were observed during 1998 surveys or have been reported in the literature:

1. POLLUTION: The type locality of *Artemisia biennis* var. *diffusa* is located downwind of the Jim Bridger Power Plant, a large coal-fired electrical plant constructed by Pacific Power and Light Company in the mid 1970s. The area inhabited by *A. biennis* var. *diffusa* may be subjected to high levels of air and water pollution and the concentration of heavy metals in soils. The potential impacts upon this population are not known. The site is still vegetated, suggesting that at least the present flora is tolerant of these conditions.

2. RECREATION: The site is adjacent to a major access road and borders lands utilized for off-road vehicle recreation. High vehicle use could impact this species through physical dislodgment or by increased soil compaction or erosion.

3. NOXIOUS WEEDS: Competition from exotic plant species, such as *Halogeton glomeratus* and *Kochia scoparia*, could have a negative impact

on populations of *A. biennis* var. *diffusa*. The potential effects of broadleaf herbicides on this species are not known.

4. GRAZING: It is not known whether var. *diffusa* is sensitive to grazing.

B. MANAGEMENT PRACTICES AND RESPONSE: No experimental data exist on the response of this taxon to management actions.

C. CONSERVATION RECOMMENDATIONS

1. RECOMMENDATIONS REGARDING PRESENT OR ANTICIPATED ACTIVITIES: *Artemisia biennis* var. *diffusa* is known from a single population that was last observed in 1980. Surveys in 1998 were unsuccessful in relocating this occurrence, or in documenting the presence of this taxon at other suitable sites in southwest Wyoming. Field data are sorely needed to ascertain even the most basic life history and habitat traits of this organism, which are in turn needed to develop management strategies. Additional field surveys should be conducted (especially in wetter years) to determine whether var. *diffusa* is still extant.

   Questions also remain as to whether var. *diffusa* is a legitimate taxonomic entity, or just an unusual growth form of the more common var. *biennis*. One solution to this problem would be to attempt to germinate ripe seeds from the type specimen at the RM. This would provide fresh genetic and morphological material for systematic studies. It remains to be determined whether these seeds are still viable after nearly two decades or if they are fertile.

2. AREAS RECOMMENDED FOR PROTECTION: No populations of *Artemisia biennis* var. *diffusa* are currently known from BLM lands and none are found within designated special management areas (Fertig *et al.* 1998). Any new populations discovered on BLM lands in the future should be assessed for potential designation as a "Special Status Plant Area of Critical Environmental Concern" (USDI Bureau of Land Management 1997).

D. STATUS RECOMMENDATIONS: *Artemisia biennis* var. *biennis* is currently managed as a Special Status plant by the BLM Rock Springs District. Due to its restricted global range and apparent rarity, this taxon may warrant federal listing as Threatened or Endangered under the Endangered Species Act. Before being considered for listing, however, nagging taxonomic questions regarding the validity of var. *diffusa* need to be resolved. Additional surveys should also be undertaken before the taxon is written off as extirpated. Unless taxonomic or field studies suggest otherwise, *A. biennis* var. *diffusa* should be managed as a Sensitive species by the BLM to ensure

that agency actions do not contribute to future endangerment of the species and the subsequent need for listing under the Endangered Species Act.

V. SUMMARY: *Artemisia biennis* var. *diffusa* is a state endemic restricted to an area of less than 5 acres north of Point of Rocks, Wyoming. This taxon has not been relocated in the wild since it was first discovered by Robert Dorn in 1980, despite at least 8 attempts by trained botanists (the latest in 1998). Dorn observed "hundreds" of plants in a clay playa at the type locality in 1980, each of which possessed an unusual short, branched growth form and small leaves. In the absence of additional material, it is uncertain whether these plants represent a legitimate taxonomic entity, or an unusual, environmentally-dictated form of the common var. *biennis*. Taxonomic questions could potentially be resolved by growing out ripe seed from the type specimen, assuming these seeds are still viable and fertile. Growing plants from these seeds would also allow for the development of a cultivated population and larger seedbank for possible reintroduction into its native range. Var. *diffusa* may be extirpated in the wild, although additional surveys of suitable habitat should be conducted (preferably in moist summers) before this assumption is made. Until taxonomic or field surveys suggest otherwise, *A. biennis* var. *diffusa* should be considered a sensitive species by the BLM and a possible future candidate for listing as Threatened or Endangered.

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Appendix A.

1998 Survey Routes