

STATUS REPORT ON  
Antennaria arcuata  
IN CENTRAL WYOMING

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

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## I. INTRODUCTION

Antennaria arcuata has been known to science only since 1950, when it was described by Arthur Cronquist based on a single specimen from Blaine County, Idaho (Cronquist 1950). Cronquist later discovered a misidentified 1905 herbarium specimen of this species from the vicinity of Atlantic City, Wyoming (Cronquist 1955). This population was not relocated until 1977. During the next decade, surveys resulted in the discovery of nearly two dozen populations in central Wyoming and Elko County, Nevada (Marriott 1986; Bayer 1992).

Due to its apparently precarious status, Antennaria arcuata was proposed for listing as Endangered by the US Fish and Wildlife Service (USFWS) and Smithsonian Institution in 1975 (Ayensu and DeFilipps 1978; Whiskey Basin Consultants 1982). This proposal was withdrawn in 1979, but the species has been a Category 2 candidate for listing ever since (US Fish and Wildlife Service 1980, 1993).

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). Antennaria arcuata is currently managed as a Special Status plant species by the BLM Rock Springs District (Amidon 1994).

In 1995, the BLM Wyoming State Office, Rawlins District, and Rock Springs District contracted on a cost-share basis with The Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) to conduct field surveys for Antennaria arcuata on public lands in central Wyoming. The objectives of this project were to collect information on the biology, distribution, habitat use, population size, and potential threats to this species to help guide management decisions.

## II. METHODS

Information on the habitat and distribution of Antennaria arcuata was obtained from secondary sources, including WYNDD files and computer databases, Rocky Mountain Herbarium (RM) collections, the 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 the author from late August to early September, 1995 (survey routes and collection sites are indicated in Appendix B). Data on biology, habitat, population size, and management needs were collected using WYNDD plant survey forms (Appendix C). Locations of occurrences were mapped

on 7.5 minute USGS topographic maps. If populations were sufficiently large, voucher specimens were collected for deposit at the RM and the Rock Springs District herbarium. Color slides were taken of A. arcuata plants and their habitats at each site. Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

Two permanent monitoring transects were established in 1995, following the general protocol of Lesica (1987). The transects consisted of a single belt 0.5 x 20-25 meters long, subdivided into 100-125 contiguous 0.2 x 0.5 meter quadrats. Within each quadrat, all plants were censused and assigned to one of three demographic classes: staminate reproductive, pistillate reproductive, and vegetative rosette. This technique generated quantitative data on population size, density, age and sex distribution, and reproductive potential. Baseline data from this transect are included in Appendix D.

### III. SPECIES INFORMATION

#### A. CLASSIFICATION

1. SCIENTIFIC NAME: Antennaria arcuata Cronquist (Cronquist 1950, pp. 41-43).
2. SYNONYMS: None.
3. COMMON NAME: Meadow pussytoes.
4. FAMILY: Asteraceae or Compositae (Sunflower family).
5. SIZE OF GENUS: In the most recent synopsis of the genus, Bayer and Stebbins (1993) recognize 35 species of Antennaria in North America (46 taxa when subspecies are included). Worldwide, approximately 45 species are recognized in northern Eurasia, North America, and southern South America (Cronquist 1955; Mabberly 1987).
6. PHYLOGENETIC RELATIONSHIPS: Antennaria arcuata belongs to the monophyletic clade "Argenteae" with two other sexual diploid taxa, A. argentea and A. luzuloides (Bayer 1992). These taxa can be distinguished from other species of Antennaria by the presence of densely pubescent stolons. The Argenteae are considered to be one of the most primitive groups within the genus, making A. arcuata of significant interest in understanding the evolutionary history of Antennaria (Bayer 1992).

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. NATIONAL:

- a. LEGAL STATUS: Antennaria arcuata has been listed as a USFWS Category 2 (C2) candidate since 1980 (US Fish and Wildlife Service 1980, 1993). Category 2 includes taxa for which there is current evidence of vulnerability, but for which USFWS lacks sufficient biological data to support a listing proposal. On 19 July 1995, USFWS revised its policy on candidate species and replaced the C2 designation with a new category "Species at Risk" (Davis 1995). Species in this category are no longer considered formal candidates for listing. At present, no official Species at Risk list has been developed for Wyoming.

A. arcuata is listed as a Special Status plant species by the BLM Rock Springs District (Amidon 1994) and has been recommended for state-wide BLM Sensitive status by WYNDD (Fertig 1994). It is also listed as a Sensitive species by US Forest Service Region 4 (Intermountain Region), although no populations are currently known from National Forest lands in Wyoming (USDA Forest Service 1991).

- b. HERITAGE RANK: Ranked G2 in The Nature Conservancy's Natural Heritage Network system. Antennaria arcuata is considered globally imperiled because of rarity or others factors making it vulnerable to extinction.

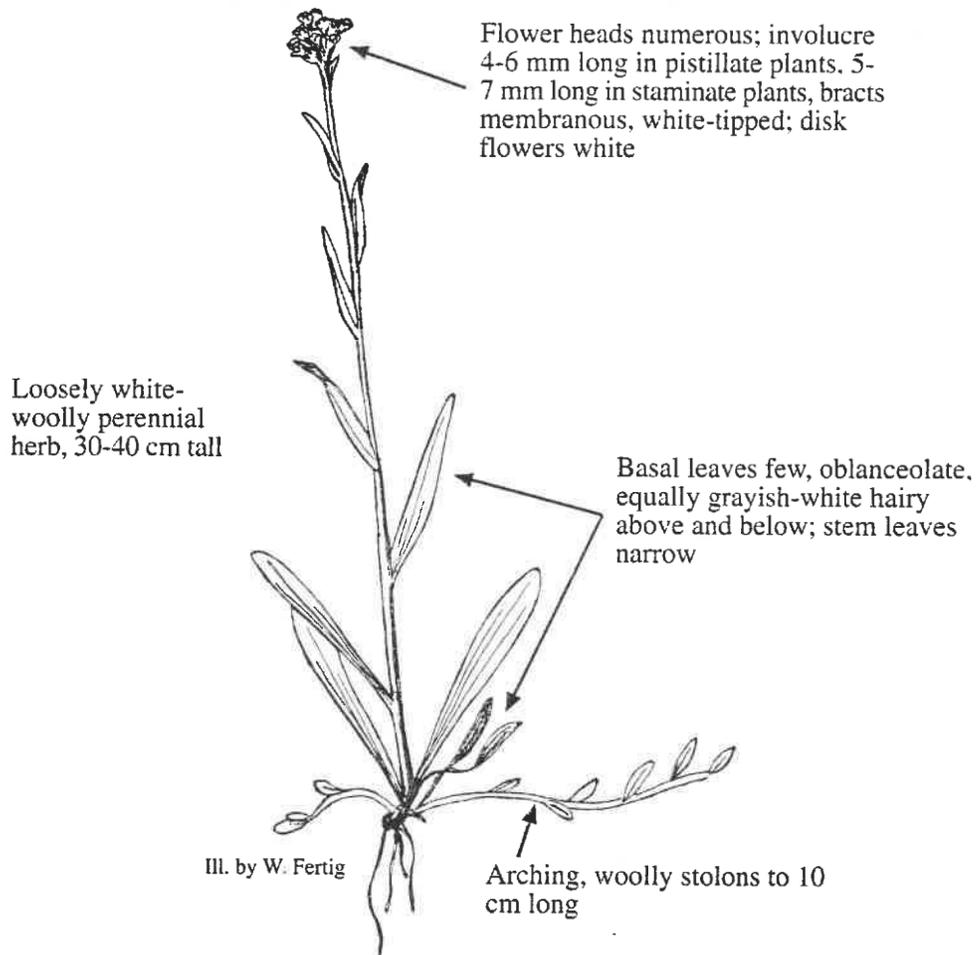
2. STATE:

- a. LEGAL STATUS: This species is not protected by state government statutes in any of the states within its range.
- b. HERITAGE RANK: Antennaria arcuata is ranked S2 in Wyoming and considered imperiled because of rarity and other factors making it vulnerable to extinction in the state (Fertig 1996). It is currently ranked S1 (critically imperiled because of rarity or some other factor making it vulnerable to extinction) in Idaho and Nevada (Lorain 1990; Jim Morefield,

C. DESCRIPTION

1. GENERAL NON-TECHNICAL DESCRIPTION: Antennaria arcuata is a white-woolly perennial herb that spreads by conspicuously arching woolly stolons up to 4 inches (10 cm) long (Figures 1-2). Flowering stems are 12-16 inches (30-40 cm) tall with relatively few oblanceolate leaves that are equally grayish-white hairy above and below. Flower heads are numerous, clustered at the tip of the stem, and have membranous, white-tipped bracts and white disk flowers (ray flowers are absent). Individual plants are unisexual. Pistillate plants have involucre 1/8-1/4 inches (4-6 mm) long, and staminate plants have involucre 3/16-5/16 inches (5-7 mm) long (Cronquist 1950; Dorn 1980, 1992; Marriott 1986; USDA Forest Service 1991; Fertig et al. 1994).
2. TECHNICAL DESCRIPTION: Plants white-woolly, perennial, spreading by means of conspicuously arching stolons about 1 dm long or less, the stolons rooting at the end and giving rise to another short-lived plant with a single strict flowering stem 3-4 dm tall; basal leaves oblanceolate, several cm long, but few and not persistent; cauline leaves narrow but well developed, moderately numerous, gradually reduced upwards; heads rather many in a close terminal cluster; involucre about 5 mm high, tomentose below, the bracts whitish and minutely striate above; pappus bristles only slightly and irregularly united at the base (Cronquist 1950).
3. LOCAL FIELD CHARACTERS: Antennaria arcuata can be recognized by its long, arching, sparsely-leafy, densely white-woolly stolons. No other Antennaria species in Wyoming has this feature.
4. SIMILAR SPECIES: Antennaria microphylla, A. parvifolia, and A. rosea have short, non-woolly stolons and densely crowded basal rosettes. A. flagellaris has slender, glabrous stolons and inflorescences composed of a single flower head. Other Antennaria species in Wyoming lack stolons, have glabrous upper leaf surfaces, or dark-tipped involucre bracts. Gnaphalium chilense is an annual or biennial herb with bisexual flower heads

Figure 1. Line drawing of *Antennaria arcuata* from Fertig et al. 1994. Illustration by W. Fertig.



and yellowish, membranous involucre bracts (Dorn 1992; Fertig et al. 1994).

#### D. GEOGRAPHICAL DISTRIBUTION

1. RANGE: Antennaria arcuata is a regional endemic found in three disjunct areas in south-central Idaho, northeastern Nevada, and central Wyoming (Bayer 1992). Currently, only one population is known in Idaho in the Huff Creek Meadows, Blaine County (Lorain 1990). Four small sites are known from the Mountain City area in Elko County, Nevada (Bayer 1992). In Wyoming, it is known only from drainage bottoms in the Sweetwater River Valley and the South Pass area of the southern Wind River Range in the vicinity of Atlantic City and Jeffrey City in Fremont County (Marriott 1986) (Figure 3).

Reports of this species from the Steens Mountains in southeastern Oregon (Henderson et al. 1977) are based on a misidentified specimen (Shultz and Shultz 1978).

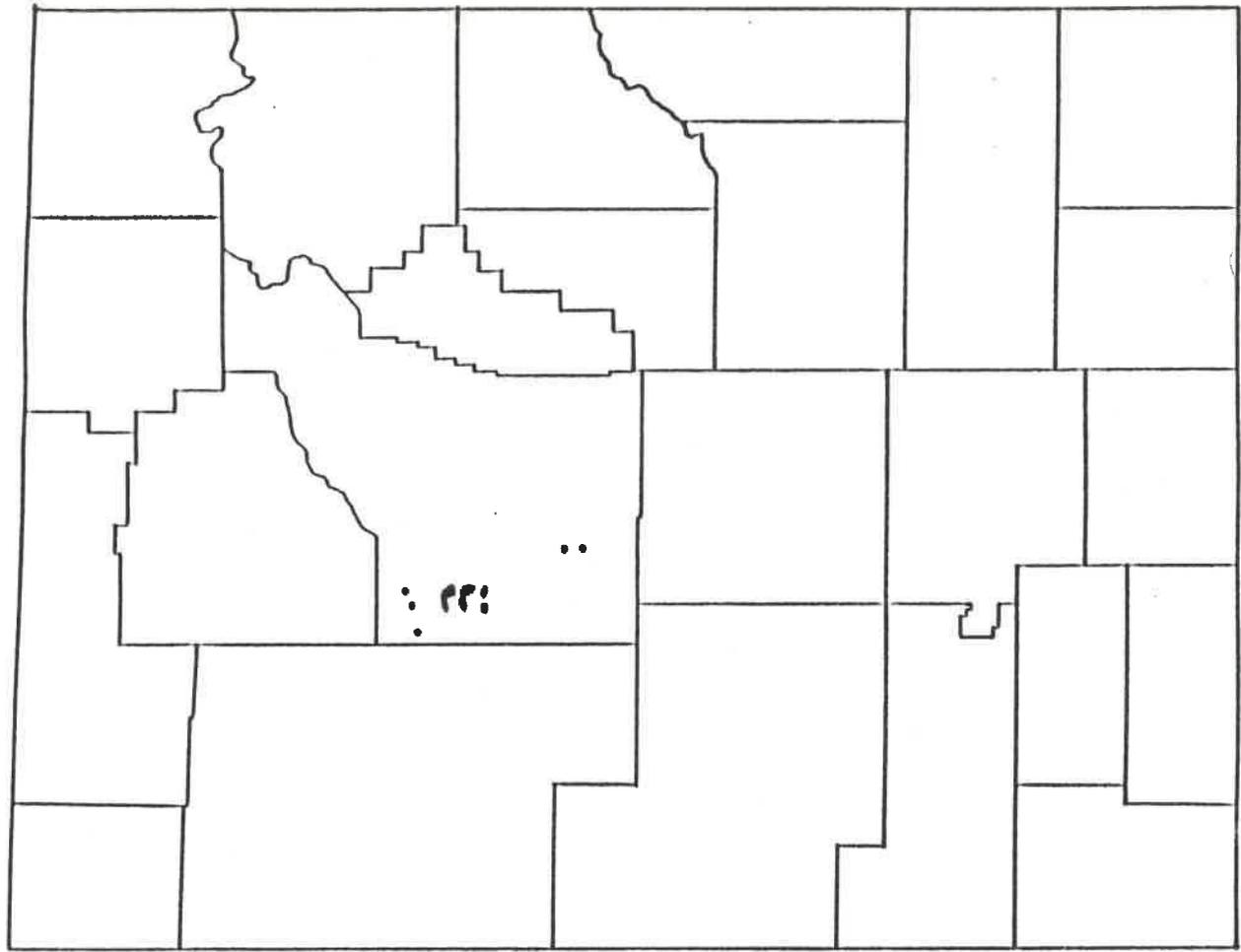
2. EXTANT SITES: In Wyoming, Antennaria arcuata is currently known from 20 locations. Eighteen of these populations are found along tributary drainages of the Sweetwater River in the vicinity of Atlantic City. The remaining occurrences are known from the vicinity of Jeffrey City. Marriott (1986) also reported 20 occurrences for Wyoming, but three of these have recently been combined with adjacent occurrence records located within the same drainages. Surveys in 1995 by WYNDD and RM staff resulted in the discovery of two new populations and the verification of one ambiguous historical record. The net result is no change in the number of recognized occurrences in Wyoming. Recent surveys in Idaho (Lorain 1990) and Nevada have failed to document additional populations in those states.

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Figure 2 (page 7). Antennaria arcuata (pistillate plant) in Juncus balticus-Deschampsia cespitosa community on edge of hummock near the headwaters of Strawberry Creek at the "Crow's Nest", Fremont County, Wyoming (EO # 015). Arching stolons are partially obscured by the adjacent rushes. WYNDD photograph by W. Fertig, 22 August 1995.



Figure 3. Distribution of Antennaria arcuata in Wyoming.



Exact locations of Wyoming populations are listed in Table 1. More detailed information is provided in the Element Occurrence Records and maps in Appendix A.

3. HISTORICAL SITES: None known in Wyoming.
4. SITES WHERE PRESENT STATUS NOT KNOWN: Two previously documented Wyoming occurrences could not be relocated in 1995 and may be extirpated. Marriott (1986) reported a small population from Pine Creek, southwest of South Pass City (EO # 017) which was not relocated in 1995. The meadow habitat at this site appears to have become overgrown by shrubs and tall grasses and may no longer be suitable for A. arcuata. The reported occurrence from the Buffalo Creek watershed northeast of Jeffrey City (EO # 019) also could not be relocated in 1995, despite being observed as recently as 1990 (Bayer 1992). Suitable habitat may still be present in the general vicinity of these populations and should be searched more thoroughly before these occurrences are assumed to be extirpated.
5. UNVERIFIED/UNDOCUMENTED REPORTS: A population from the upper Chimney Creek drainage (EO # 021) was originally reported by Whiskey Basin Consultants (1982), but was not recognized by Marriott (1986) due to the lack of a corroborating voucher specimen. This population was confirmed to be extant in 1995. No other unverified or undocumented reports are currently known from Wyoming.
6. AREAS SURVEYED BUT SPECIES NOT LOCATED: Surveys in Wyoming in 1995 focused on potential subirrigated meadow habitat along the Sweetwater River and its tributaries from South Pass to the Granite and Green Mountains near Jeffrey City. Unsuccessful searches were conducted along West Sage Hen, Middle Fork Sage Hen, Buffalo, and East Fork Long creeks in the Granite Mountains north of Jeffrey City and along Crooks Creek in the Green Mountains. Failed searches included areas along Elkhorn Draw, Coyote and Buffalo Gulches, and West Pacific, Dickie Springs, Middle Fork North Fork Sulphur, West Alkali, East Alkali, Ladysmith, Silver, and Warm Springs creeks in the South Pass City area. Survey routes are shown in Appendix B.

Table 1. Location Information for Known Populations of  
Antennaria arcuata in central Wyoming.

Note: Due to the combination of some records, there are no Wyoming occurrences numbered 002, 008, and 014.

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Occurrence # 001

County: Fremont.

Legal Description: T28N R98W S8 (NE4 of NW4).

Latitude: 42° 25' 07" N.

Longitude: 108° 32' 55" W.

Elevation: 7300 ft (2225 m).

USGS 7.5' Quad: Radium Springs.

Location: Vicinity of Burr Mine [Burr Gulch], ca 1 mile north of the Sweetwater River.

Occurrence # 003

County: Fremont.

Legal Description: T28N R98W S11 (SE4 of SE4), 15 (S2 & SE4 of NE4), and 22 (E2 of NW4).

Latitude: 42° 23' 45" N (centrum).

Longitude: 108° 30' 22" W (centrum).

Elevation: 7300 ft (2225 m).

USGS 7.5' Quad: Lewiston Lakes and Radium Springs.

Location: Granite Creek drainage, ca 0.1 miles north of Chicken Springs and ca 1.3 air miles south of the Sweetwater River. Also on Granite Creek ca 1 mile upstream of the Sweetwater River on south bank.

Occurrence # 004

County: Fremont.

Legal Description: T28N R98W S13 (SW4) and 24 (NW4).

Latitude: 42° 23' 32" N (centrum).

Longitude: 108° 28' 21" W (centrum).

Elevation: 7200 ft (2195 m).

USGS 7.5' Quad: Lewiston Lakes.

Location: Mormon Creek, in vicinity of Mormon Springs, ca 2 air miles south of the Sweetwater River.

Occurrence # 005

County: Fremont.

Legal Description: T28N R99W S4 (SW4 of SW4), 5 (SE4 of SE4), and 8 (NE4 of NE4).

Latitude: 42° 25' 25" N (centrum).

Longitude: 108° 39' 15" W (centrum).

Elevation: 7300-7350 ft (2225-2240 m).

USGS 7.5' Quad: Atlantic City.

Location: Tributary to east of Willow Creek, ca 3 air miles north of the Sweetwater River, ca 5-6 miles southeast of Atlantic City.

Occurrence # 006

County: Fremont.

Legal Description: T28N R99W S22 (S2), 27 (NW4), and 28 (NE4).

Latitude: 42° 22' 40" N (centrum).

Longitude: 108° 37' 52" W (centrum).

Elevation: 7200 ft (2195 m).

USGS 7.5' Quad: Atlantic City and Radium Springs.

Location: Long Slough, ca 1 air mile south of the Sweetwater River on the west side of BLM Road 2317.

Table 1. (continued)

Occurrence # 007

County: Fremont.

Legal Description: T28N R99W S13 (S2 of SW4), 23 (S2 of SE4), 24 (W2 of NW4 & NW4 of SW4), 26 (SW4 of SW4), 27 (SE4 of SE4), and 34 (NE4 of NE4).

Latitude: 42° 23' 13" N (centrum).

Longitude: 108° 35' 30" W (centrum).

Elevation: 7200-7300 ft (2195-2225 m).

USGS 7.5' Quad: Circle Bar Lake and Radium Springs.

Location: Harris Slough, just south of the Sweetwater River, ca 1 mile west of Buffalo Gulch. Also on tributary of Harris Slough, ca 2 air miles south of the Sweetwater River, ca 4 miles west of the Antelope Hills.

Occurrence # 009

County: Fremont.

Legal Description: T28N R98W S2 (NW4 of NE4 of NE4). T29N R97W S30 (S2 of SW4 & SW4 of NE4) and 31 (W2 of NW4, NW4 of NE4, & SW4). T29N R98W S36 (E4 of SE4).

Latitude: 42° 27' 05" N (centrum).

Longitude: 108° 28' 35" W (centrum).

Elevation: 7200-7340 ft (2195-2240 m).

USGS 7.5' Quad: Lewiston Lakes.

Location: McLean Meadows and adjacent small tributary drainages of the Sweetwater River on its north bank, just east of the confluence of Strawberry Creek, 0.5-1 air miles west of the Lewiston Lakes.

Occurrence # 010

County: Fremont.

Legal Description: T29N R98W S14 (SW4 of NW4).

Latitude: 42° 29' 25" N (centrum).

Longitude: 108° 30' 40" W (centrum).

Elevation: 7300 ft (2225 m).

USGS 7.5' Quad: Radium Springs.

Location: Level Meadows Creek drainage east of Atlantic City, ca 5 miles north of the Sweetwater River.

Occurrence # 011

County: Fremont.

Legal Description: T29N R98W S22 (SW4 of SW4), 27 (NW4), and 28 (NE4).

Latitude: 42° 28' 05" N (centrum).

Longitude: 108° 32' 25" W (centrum).

Elevation: 7500-7560 ft (2285-2300 m).

USGS 7.5' Quad: Radium Springs.

Location: Upper Deep Creek, on north side of Atlantic City-Hudson Road, ca 10.5 air miles east-southeast of Atlantic City.

Occurrence # 012

County: Fremont.

Legal Description: T29N R98W S26 (W2) and 35 (NE4 of NW4).

Latitude: 42° 27' 33" N (centrum).

Longitude: 108° 30' 55" W (centrum).

Elevation: 7400 ft (2255 m).

USGS 7.5' Quad: Radium Springs.

Location: Diamond Creek from the south side of the Atlantic City-Sweetwater Station Road south ca 1 mile to its confluence with Deep Creek near the Gilesie Cabin Historic Site and Radium Springs, ca 2.25-3.25 miles north of the Sweetwater River.

Table 1. (continued)

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Occurrence # 013  
County: Fremont.  
Legal Description: T29N R98W S29 (NW4 of SW4 and 30 (SE4 of SE4).  
Latitude: 42° 27' 15" N (centrum).  
Longitude: 108° 34' 47" W (centrum).  
Elevation: 7500-7540 ft (2285-2300 m).  
USGS 7.5' Quad: Radium Springs.  
Location: Northeast fork of Upper Strawberry Creek, and ca 0.2 miles north of the Atlantic City-Hudson Road.

Occurrence # 015  
County: Fremont.  
Legal Description: T29N R99W S13 (E2 of SW4 & NW4 of SE4).  
Latitude: 42° 29' 02" N (centrum).  
Longitude: 108° 36' 45" W (centrum).  
Elevation: 7600-7640 ft (2315-2330 m).  
USGS 7.5' Quad: Radium Springs.  
Location: Headwaters of Strawberry Creek at the Crow's Nest, 6-6.5 miles north of the Sweetwater River.

Occurrence # 016  
County: Fremont.  
Legal Description: T29N R99W S25 (W4), 26 (E4), and 35 (NE4).  
Latitude: 42° 27' 12" N (centrum).  
Longitude: 108° 37' 12" W (centrum).  
Elevation: 7400 ft (2255 m).  
USGS 7.5' Quad: Radium Springs.  
Location: Along tributary northeast of Rock Creek, ca 0.5 air miles north of the Handcart Site on the Oregon Trail.

Occurrence # 017  
County: Fremont.  
Legal Description: T28N R101W S1 (NW4 of NW4).  
Latitude: 42° 26' 00" N.  
Longitude: 108° 49' 40" W.  
Elevation: 7700 ft (2345 m).  
USGS 7.5' Quad: South Pass City.  
Location: Pine Creek, ca 2.7 air miles south-southwest of South Pass City.

Occurrence # 018  
County: Fremont.  
Legal Description: T29N R101W S34 (ctr NE4 & SE4 of SE4).  
Latitude: 42° 26' 40" N.  
Longitude: 108° 52' 40" W.  
Elevation: 7900 ft (2410 m).  
USGS 7.5' Quad: Anderson Ridge and South Pass City.  
Location: Fish Creek at crossing with WY Highway 28 at southwestern-most turnoff to South Pass City, ca 8.5 air mi west-southwest of Atlantic City.

Occurrence # 019  
County: Fremont.  
Legal Description: T31N R92W S8 (SE4 of SE4) and 17 (NE4 of NE4).  
Latitude: 42° 39' 57" N.  
Longitude: 107° 51' 30" W.  
Elevation: 6840-6900 ft (2085-2105 m).  
USGS 7.5' Quad: Muskrat Basin.  
Location: Tributary to west of Buffalo Creek, ca 12 air miles east-northeast of Jeffrey City.

Table 1. (continued)

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Occurrence # 020

County: Fremont.

Legal Description: T31N R93W S1 (NW4 of SW4) and 2 (NE4 of SE4).

Latitude: 42° 41' 15" N.

Longitude: 107° 54' 55" W.

Elevation: 6900-7000 ft (2105-2135 m).

USGS 7.5' Quad: Tin Cup Mountain.

Location: East Fork of East Long Creek, ca 14 air mi north-northwest of Jeffrey City.

Occurrence # 021

County: Fremont.

Legal Description: T29N R97W S29 (SW4 of SE4 of SE4) and 32 (NW4 of NE4 of NE4).

Latitude: 42° 27' 12" N (centrum).

Longitude: 108° 26' 42" W (centrum).

Elevation: 7250 ft (2210 m).

USGS 7.5' Quad: Lewiston Lakes.

Location: Upper end of Chimney Creek, ca 0.2 miles northeast of the uppermost of the Lewiston Lakes, ca 1.4 air miles north of Sweetwater River Canyon.

Occurrence # 022

County: Fremont.

Legal Description: T27N R100W S29.

Latitude: 42° 17' 17" N.

Longitude: 108° 46' 52" W.

Elevation: 7572-7600 ft (2305-2315 m).

USGS 7.5' Quad: Dickie Springs.

Location: "Ca 4 air miles west of Continental Peak and ca 5 air miles northeast of Oregon Buttes" [in the Oregon Gulch drainage].

Occurrence # 023

County: Fremont.

Legal Description: T28N R97W S21 (SE4 of NW4).

Latitude: 42° 23' 27" N (centrum).

Longitude: 108° 24' 50" W (centrum).

Elevation: 7370 ft (2245 m).

USGS 7.5' Quad: Lewiston Lakes.

Location: South Fork of Willow Creek in vicinity of spring, 2.5 air miles south of confluence of Willow Creek and Sweetwater River, ca 1 mile north of Strawberry Creek.

## E. HABITAT

1. ASSOCIATED VEGETATION: In Wyoming, Antennaria arcuata is found primarily in subirrigated meadows within broad stream channels dominated by tufted hairgrass (Deschampsia cespitosa), Baltic rush (Juncus balticus), Kentucky bluegrass (Poa pratensis), Nevada bluegrass (P. nevadensis), junegrass (Koeleria macrantha), and clustered field sedge (Carex praegracilis) (Figures 4-5). These communities are often found in a matrix of silver sagebrush (Artemisia cana) and shrubby cinquefoil (Pentaphylloides floribunda). Within these communities A. arcuata may be found on hummocks, level ground, or shallow depressions on alkaline, clayey soils high in organic matter. At higher elevations in the South Pass area it may be found at the edge of silver sagebrush stands and willow thickets in subirrigated meadows of tufted hairgrass, Baltic rush, spike-rush (Eleocharis sp.) and meadow barley (Hordeum brachyantherum).

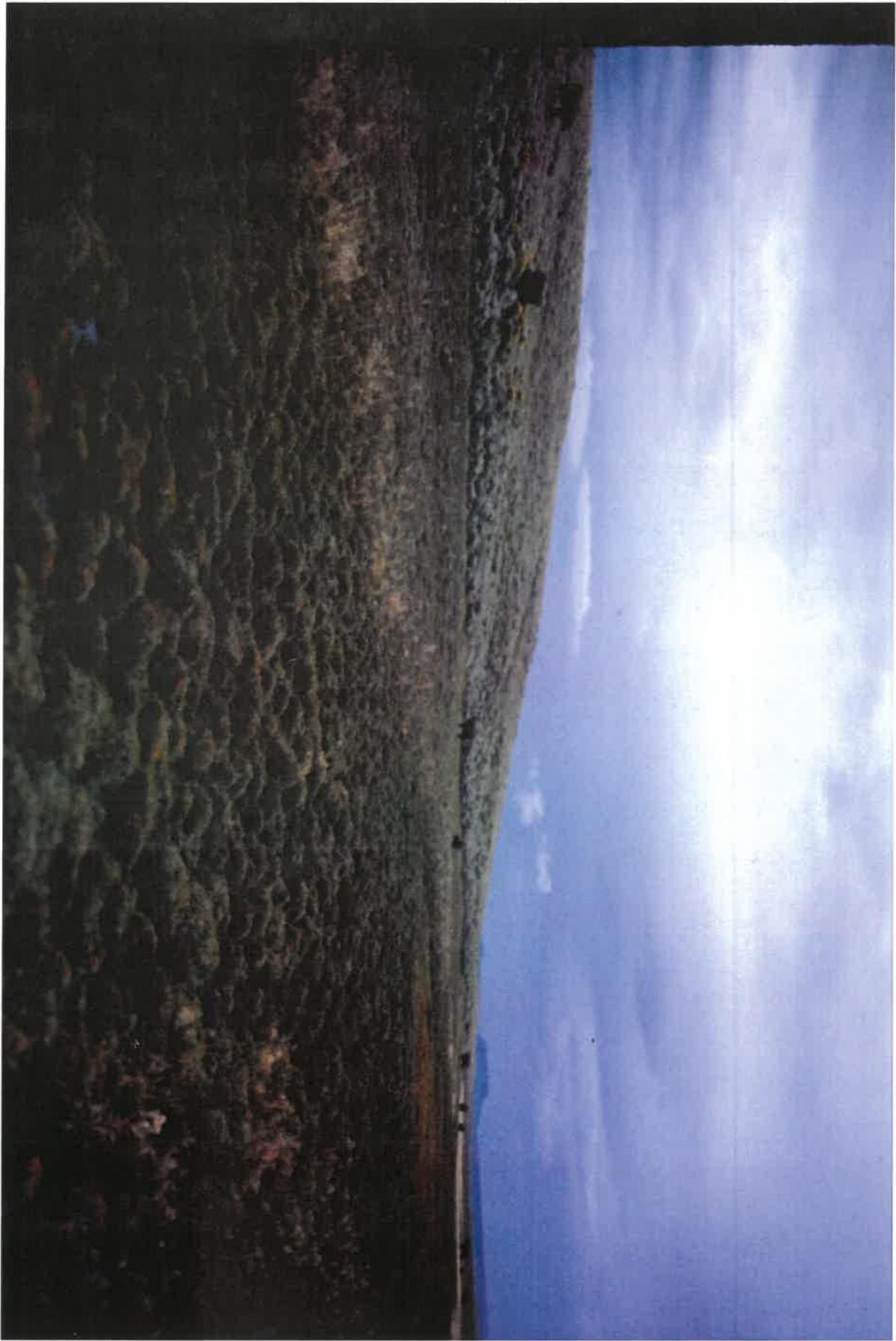
A. arcuata is notably absent from riparian sites with tall, dense graminoid or shrub cover and where soils are saturated. This species is also absent from the dry, gravelly big sagebrush (Artemisia tridentata) grassland ridges that border the riparian zone.

2. FREQUENTLY ASSOCIATED SPECIES:

Achillea millefolium (Common yarrow)  
Agoseris glauca var. glauca (Pale agoseris)  
Antennaria corymbosa (Flat-topped pussytoes)  
Antennaria microphylla (Small-leaved pussytoes)  
Artemisia cana (Silver sagebrush)  
Aster ascendens (Long-leaved aster)  
Aster falcatus var. commutatus (Creeping white prairie aster)  
Astragalus agrestis (Field milkvetch)  
Astragalus bodinii (Bodin's milkvetch)

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Figure 4 (page 15). Habitat of Antennaria arcuata in hummocky meadow dominated by Deschampsia cespitosa and Juncus balticus along Long Creek, Fremont County, Wyoming (EO # 006). This species may also be found in non-hummocky meadows with or without high cover of granitic rock. In hummocky areas, A. arcuata is most abundant in flat areas between hummocks where soils are slightly wetter and better drained. WYNDD photograph by W. Fertig, 23 August 1995.



C

C

C

Carex nebrascensis (Nebraska sedge)  
Carex praegracilis (Clustered field sedge)  
Cirsium scariosum (Elk thistle)  
Deschampsia cespitosa (Tufted hairgrass)  
Dodecatheon pulchellum (Dark-throat shooting-  
 star)  
Eleocharis sp. (Spike-rush)  
Erigeron lonchophyllus (Short-rayed daisy)  
Gentiana affinis var. affinis (Prairie gentian)  
Haplopappus uniflorus (One-flowered goldenweed)  
 [syn = Pyrrocoma uniflora]  
Hordeum brachyantherum (Meadow barley)  
Iris missouriensis (Western blue iris)  
Juncus balticus var. montanus (Baltic rush)  
Juncus longistylis (Long-styled rush)  
Koeleria macrantha (Junegrass)  
Muhlenbergia filiformis (Slender muhly)  
Pentaphylloides floribunda (Shrubby cinquefoil)  
 [syn = Potentilla fruticosa]  
Phleum alpinum (Alpine timothy)  
Phlox kelseyi (Kelsey's phlox)  
Poa nevadensis (Nevada bluegrass)  
Poa pratensis (Kentucky bluegrass)  
Poa secunda (Sandberg bluegrass)  
Potentilla anserina (Common silverweed)  
Potentilla gracilis (Slender cinquefoil)  
Solidago nana (Low goldenrod)  
Trifolium longipes (Long-stalked clover)

3. TOPOGRAPHY: Most populations of Antennaria arcuata in Wyoming are associated with rounded hummocks found within broad, gently sloping drainage bottoms of various exposures surrounded by low ridges (Figure 6). A. arcuata plants are found primarily in the flat spaces between hummocks, or on the lower sides of mounds where soils appear to be slightly moister, better drained, and more shaded than on the hummock tops. Occasionally, populations can also be found on flat (non-hummocky) terrain or in shallow swales at the edge of drainage bottoms. Known occurrences in Wyoming range in elevation from 6840-7900 feet (2070-2410 m).

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Figure 5 (page 17). Habitat of Antennaria arcuata in subirrigated, gently rolling stream bottoms without noticeable hummocks along Diamond Creek, just south of the enclosure (EO # 012). Plants evident as gray spots in the foreground. WYNDD photograph by W. Fertig, 20 August 1995

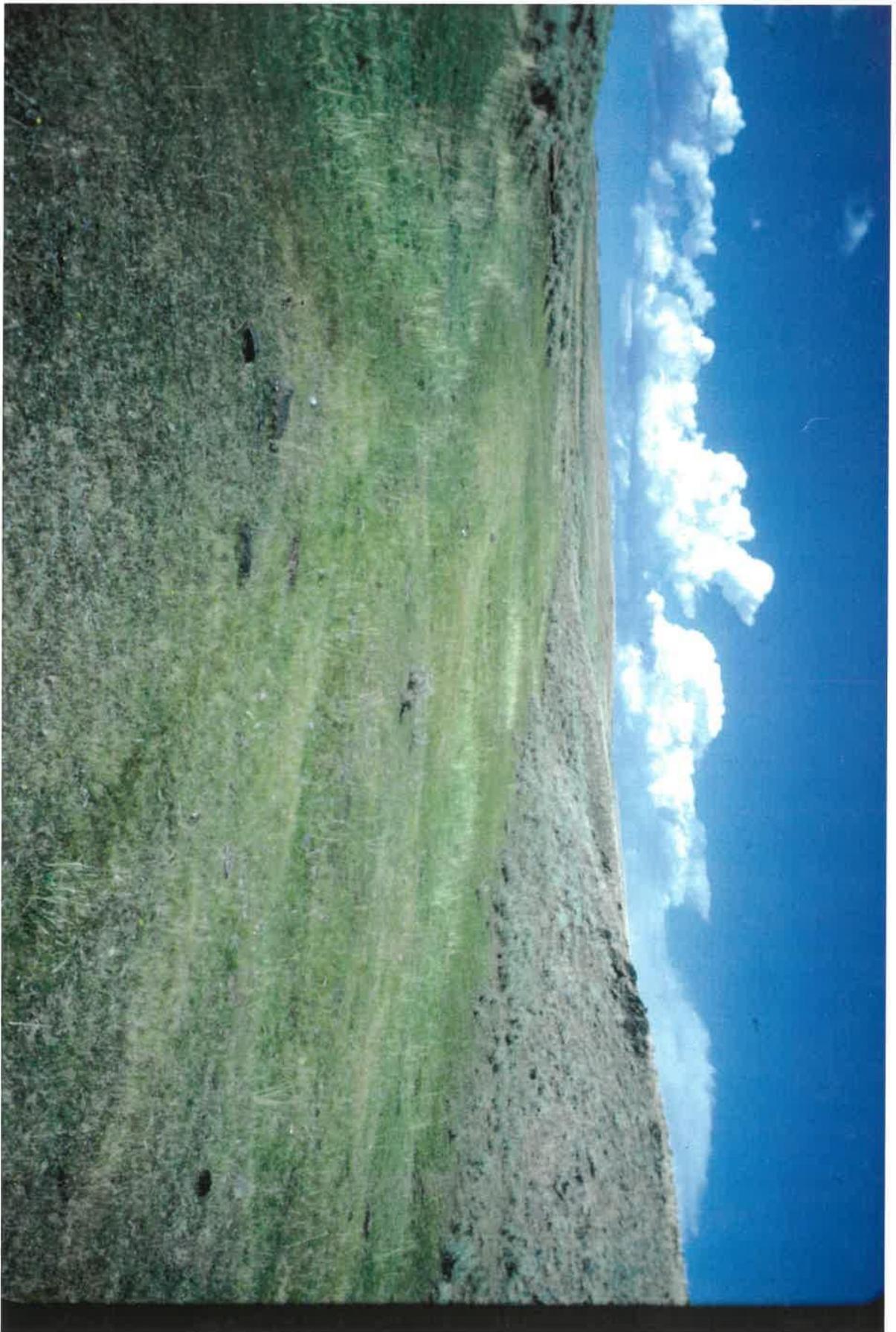
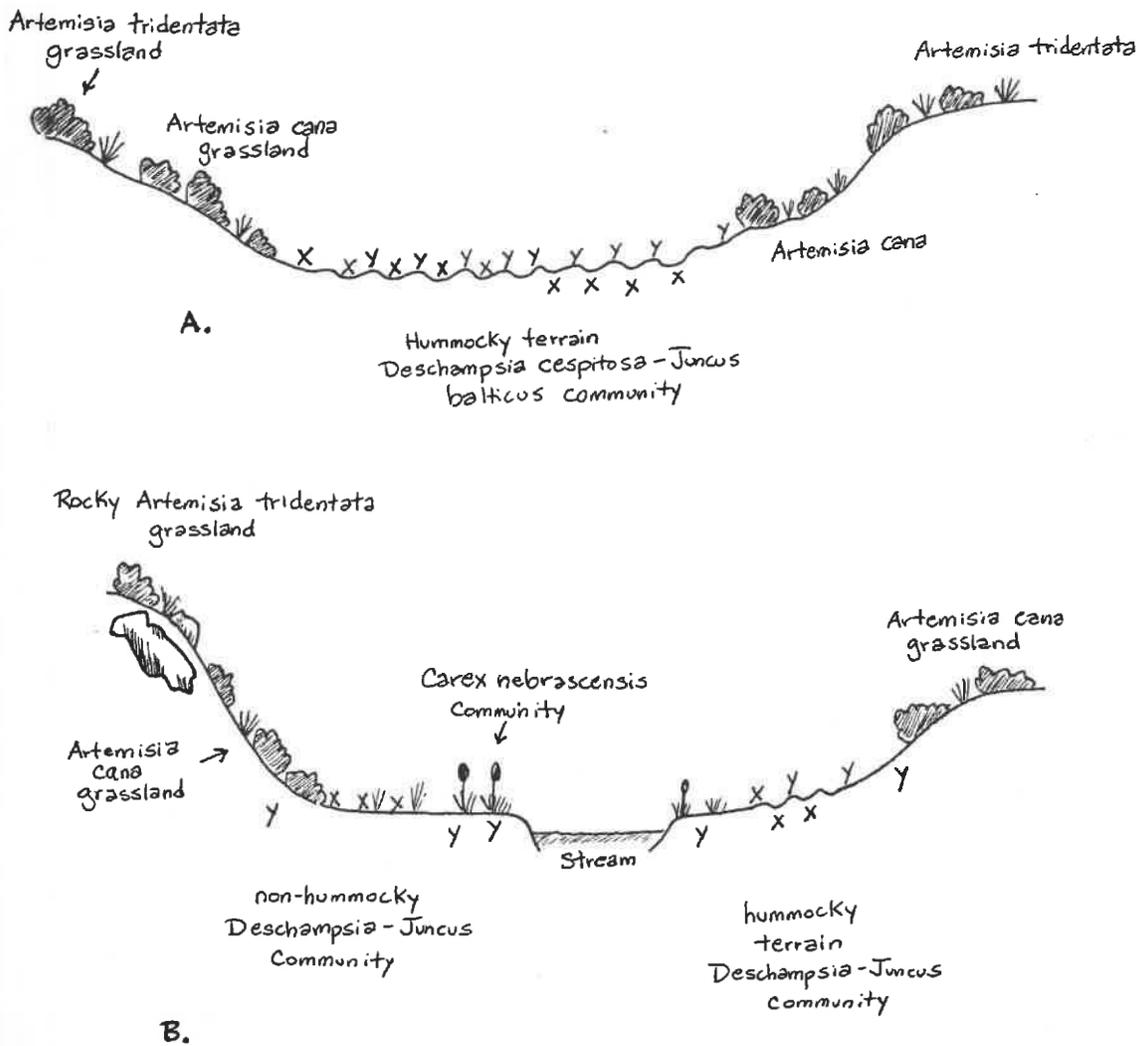


Figure 6. Topographic position of Antennaria arcuata on the landscape. A. Occurrence # 013 along Strawberry Creek. A. arcuata is located primarily in the flat spaces among the hummocks. B. Occurrence # 007 along Harris Slough. A. arcuata is found on hummocky and non-hummocky benches in the narrow channel between upland slopes of Artemisia and wetlands dominated by Carex nebrascensis. X = Antennaria arcuata; Y = Antennaria microphylla. Illustration by W. Fertig.



4. SOIL RELATIONSHIPS: Bayer (1992) analyzed soils from six populations of Antennaria arcuata in Wyoming, Idaho, and Nevada. Soils from these sites ranged from neutral to basic, and had high concentrations of calcium, magnesium, and sodium. Most sites were also found to be rich in organic matter. Low levels of selenium were found in assays of A. arcuata plants, suggesting that thistoxic compound is also present in low levels in the soil. Soils from the Jeffrey City area (EO # 019) were found to differ from other sample sites in Wyoming in having higher concentrations of zinc and selenium and lower amounts of organic matter, iron, phosphorus, manganese, and nitrogen. Soil samples from Nevada and Idaho were also found to differ in the concentration of soil nutrients, organic matter, and cation exchange capacity.

Known occurrences of A. arcuata in Wyoming are found primarily on soils derived from Quaternary sandy alluvial deposits (Love and Christiansen 1985). These soils may have a whitish, alkaline crust and have a well-developed layer of mosses and cryptogams on the surface. The population from Fish Creek in the southern foothills of the Wind River Range (EO # 018) differs from other Wyoming occurrences in having non-alkaline, black humus-rich soils.

A. arcuata populations from Nevada are reported from black clay soils and silt/loams, while those from Idaho are found on moist, alkaline substrates (Lorain 1990).

5. REGIONAL CLIMATE: Average annual precipitation within the Wyoming range of Antennaria arcuata varies from 10 inches (254 mm) near Jeffrey City to 12-14 inches (305-355 mm) in the vicinity of South Pass City (Martner 1986). Precipitation is highest at South Pass City in early winter (December-January) and spring (April-June). Mean annual temperature ranges from 44° F (6.6° C) at Jeffrey City to 36-42° F (2.2-5.5° C) near South Pass City. Mean maximum and minimum temperatures in January are 26-30° F (-3.3- -1° C) and 2-10° F (-16.6- -12.2° C). In July, mean maximum and minimum temperatures are 83° F (28.3° C) and 42-54° F (5.5-12.2° C).
6. LOCAL MICROCLIMATE: The meadow habitats of Antennaria arcuata in Wyoming remain moist (at

least below the surface) late into the summer, long after the surrounding uplands have become completely desiccated.

#### F. POPULATION BIOLOGY AND DEMOGRAPHY

1. PHENOLOGY: In Wyoming, flowering occurs from July to September. Mature fruits may be found from late August to September.
2. POPULATION SIZE AND CONDITION: Antennaria arcuata is currently known from 20 occurrences in Wyoming and 5-6 sites in Idaho and Nevada (Lorain 1990; Bayer 1992). Individual Wyoming occurrences range in size from 2 to over 90 acres and are often divided into numerous smaller subpopulations in areas of suitable habitat. The total area occupied by A. arcuata in Wyoming is between 400-500 acres.

Fifteen Wyoming occurrences were censused in 1995 (Table 2). These populations were found to range in size from 200 to approximately 30,000 individuals. Based only on these occurrences, the total Wyoming population is currently estimated to be between 99,900-131,350 plants. This figure is probably conservative due to the lack of census data for the five other known occurrences in the state.

Trend data are available for twelve of the Wyoming occurrences surveyed in 1995. Six of these occurrences show an apparent downward trend since 1982, four show an increase, and one is stable. The most significant downward trend was observed in the vicinity of Willow Creek (EO # 005), where the population has dropped from an estimated 35,560 plants in 1982 to 1500-2000 individuals in 1995. This and other population changes (both declines and increases), however, may be due partly to unequal sampling rather than changes in population size. Overall, the total state population appears to be stable to slightly declining since 1982.

Populations studied in 1995 were found to consist of widely scattered but often densely clustered unisexual "clones" of flowering and vegetative plants. Total density was found to range from 38-105 plants per square meter in demographic plots. Vegetative rosettes typically outnumbered flowering plants by factors greater than 5:1,

although in rare instances rosettes outnumbered flowering plants by over 80:1. The density of flowering plants ranged from 6-17 in sample plots. Both staminate and pistillate individuals occurred within the same populations in approximately equal numbers.

### 3. REPRODUCTIVE BIOLOGY:

- a. TYPE OF REPRODUCTION: Antennaria arcuata is a perennial that reproduces vegetatively by spreading stolons or sexually by seed. Although many species of Antennaria also reproduce asexually by apomixis (the production of viable seed produced without fertilization or meiosis), there is no evidence to suggest that A. arcuata is capable of this type of reproduction (Bayer 1984). Chromosome counts and demographic analysis of Nevada and Wyoming populations have shown that A. arcuata is a diploid with populations containing approximately equal proportions of staminate and pistillate individuals (Bayer 1992). Known apomictic species of Antennaria are polyploids with populations consisting almost entirely of pistillate plants (Bayer 1984; Cronquist 1994).

Bayer (1992) found that the amount of genetic diversity within populations of A. arcuata was much lower than that of other narrowly endemic or wide-ranging sexual species of Antennaria. Due to inbreeding within populations and low gene flow between populations, Bayer also observed small, but meaningful differences in the genetic structure of six A. arcuata occurrences in Nevada, Idaho, and Wyoming. These observations support Bayer's contention that populations of this species have been isolated from each other for a relatively long time (Bayer 1992).

- b. POLLINATION BIOLOGY: The specific pollination vectors of Antennaria arcuata have not been reported in previous studies (Marriott 1986; Lorain 1990). The occurrence of separate sexes and the absence of apomictic reproduction requires this species to be an outcrosser. The reduced flower size and lack of showy, petal-like ray flowers suggests

Table 2. Demographic Information for Surveyed Populations of Antennaria arcuata in Central Wyoming.

Note: For additional information, see Appendix B.

Occurrence # 003

Area: 25 + acres.

Number and Age of Plants: Population estimated at 21,500-30,000 reproductive and vegetative individuals in one of two known colonies in 1995. The second, smaller colony was not relocated.

Density: Individual clones dense with plants arranged in a clumped, non-random pattern. Clones themselves may be widely scattered.

Evidence of Reproduction: Plants found in flower and fruit. Ratio of pistillate to staminate plants approximately 1:1.

Population Trend: This same population was estimated to contain 11,353 individuals in 1982. A smaller satellite colony was found to have 50-100 plants in 1986. The total population appears to have nearly doubled in size.

Occurrence # 004

Area: 20 acres.

Number and Age of Plants: Population estimated at 6100-7500 reproductive and vegetative individuals in 1995.

Density: Plants may be locally abundant, but colonies are patchy.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones present.

Population Trend: This population has been known since 1982, but long-term trend information is not available.

Occurrence # 005

Area: 10-15 acres.

Number and Age of Plants: Population estimated at 1500-2000 reproductive and vegetative individuals in 1995. Vegetative rosettes appear to outnumber flowering plants by a ratio of 3:1.

Density: Distribution patchy, but may be locally dense.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones present.

Population Trend: This population was estimated to contain 35,560 plants in 1982 (based on extrapolation of a sample of 3556 plants). It appears that the population has declined sharply on BLM lands in the occurrence since then. No plants were found within a BLM range enclosure in 1995.

Occurrence # 006

Area: 35 acres.

Number and Age of Plants: Population estimated at 20,000-30,000 reproductive and vegetative individuals in 1995. Vegetative rosettes appear to outnumber flowering plants by about 5:1.

Density: At one transect site, density was measured at 105.3 plants per square meter (including 17.7 flowering plants per square meter).

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed. Staminate plants appear to slightly outnumber pistillate plants.

Population Trend: This population was estimated to contain 30,700 plants in 1982, and so appears to be stable.

Occurrence # 007

Area: 90 acres.

Number and Age of Plants: Population estimated at 7800-8500 reproductive and vegetative individuals in one portion of the EO (TNC Sweetwater Preserve) in 1995. Vegetative rosettes appear to outnumber flowering plants by a ratio of 5.4:1.

Density: At one transect site, density was measured at 38.8 plants per square meter (including just over 6 flowering plants per square meter).

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed. Staminate plants appear to outnumber pistillate plants by a ratio of 1.3:1.

Population Trend: This EO has been known since 1982, but trend data are lacking.

Table 2 (continued)

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Occurrence # 009

Area: 70 acres.

Number and Age of Plants: Total population estimated at 8500-11,500 reproductive and vegetative individuals at 4 colonies in 1995. Rosettes may outnumber flowering plants by as much as 15:1 at some sites.

Density: Plants often tightly clustered, but clusters themselves may be widely dispersed.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate plants observed.

Population Trend: This occurrence was estimated to contain over 20,000 plants in 1982. The entire area was not resurveyed in 1995, so trends are not completely known.

Occurrence # 011

Area: 10 + acres.

Number and Age of Plants: Total population estimated at 3600-4200 reproductive and vegetative individuals in 5 colonies in 1995. Vegetative rosettes observed to outnumber flowering plants by ca 3:1 at some sites.

Density: Plants typically clumped, but clumps themselves are widely dispersed and patchy.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: This occurrence was first reported in 1982, but no population data were reported. "100 +" plants observed in brief 1986 survey. The higher numbers observed in 1995 may represent either be an artifact of more intensive sampling or an increase in population size in the last decade.

Occurrence # 012

Area: 25 acres.

Number and Age of Plants: Population estimated at 5300-8500 reproductive and vegetative individuals in 2 colonies in 1995. 10-15% of all plants estimated to be in flower or fruit.

Density: Plants tend to be clumped, but clumps themselves are widely dispersed.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: This population has been known since 1979. A census in 1980 estimated the total population at ca 3000 individuals. This colony appears to have doubled since then. No plants were observed within 2 BLM exclosures in 1995.

Occurrence # 013

Area: 25 acres.

Number and Age of Plants: Total population estimated at 1700-2300 reproductive and vegetative individuals in 2 colonies in 1995. Approximately 75% in vegetative condition.

Density: Distribution non-random and clumped, each clump containing ca 30-50 individuals. Clumps themselves often widely scattered.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: Population estimated at 3300 plants in 1982. A portion of the occurrence in 1995 appeared to have been replaced by shrubby vegetation since 1982, possibly accounting for a decline in total population numbers at this site.

Occurrence # 015

Area: 20 acres.

Number and Age of Plants: Total population estimated at 5200-6300 reproductive and vegetative individuals in two large colonies in 1995. Vegetative rosettes outnumbered flowering plants by 40:1 in some patches.

Density: As many as 20 plants per square foot were observed in some sites. Clones tend to be dense but widely scattered.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: Population estimated at 3415 plants in 1982 in a smaller search area. The discrepancy in population size between 1982 and 1995 may be due to more complete sampling in 1995 rather than a population increase.

Table 2 (continued)

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Occurrence # 017

Area: Not known.

Number and Age of Plants: No plants could be found in surveys in 1995.

Density: Not known.

Evidence of Reproduction: No reproductive plants observed in 1995.

Population Trend: This population contained an estimated 100-150 plants in 1986. The area mapped by Marriott (1986) appeared to be overgrown by shrubs and tall grasses in 1995 and may be locally extirpated.

Occurrence # 018

Area: 2 + acres.

Number and Age of Plants: Population estimated at ca 250 mostly vegetative plants in 1995. Only 3 flowering plants observed.

Density: Patches locally dense but widely scattered.

Evidence of Reproduction: Only 3 pistillate plants observed. No staminate plants observed.

Population Trend: Population estimated at 300-500 individuals in 1986. This occurrence may be in a slow decline.

Occurrence # 019

Area: Not known.

Number and Age of Plants: No plants could be found in 1995.

Density: Not known.

Evidence of Reproduction: No flowering or fruiting plants observed in 1995.

Population Trend: Population estimated at 200-400 individuals in 1986. Relocated in 1990, but census data not available (Bayer 1992). Some potential habitat still exists in the vicinity and should be investigated before this occurrence is determined to be extirpated.

Occurrence # 021

Area: 3-5 acres.

Number and Age of Plants: Population estimated at 200-300 reproductive and vegetative individuals in 1995.

Density: Patches small and scattered.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: This population was reported in 1982, but no census data are available to determine trends.

Occurrence # 023

Area: 7 acres.

Number and Age of Plants: Population estimated at 18,250-20,000 reproductive and vegetative individuals in 1995.

Density: Locally abundant and densely clustered. Clusters themselves may be widely dispersed.

Evidence of Reproduction: Plants found in flower and fruit. Both staminate and pistillate clones observed.

Population Trend: This occurrence was newly discovered in 1995. No trend data are available.

that the species may be dependent on wind dispersal of pollen, although small insects may also be responsible.

- c. SEED DISPERSAL AND BIOLOGY: Seeds of Antennaria arcuata are probably dispersed by wind or gravity (Lorain 1990). Establishment of seedlings appears to be restricted to relatively mesic microsites within existing colonies. Under present climatic conditions, establishment of seedlings in new habitats outside of the current range of the species is unlikely (Bayer 1992).

Previous studies have questioned whether A. arcuata can produce viable seed, due to the perceived absence of staminate plants to ensure pollination (Lorain 1990). Studies by Bayer (1992) and surveys in 1995 have demonstrated that staminate plants are equally abundant to pistillate plants and capable of producing pollen in Wyoming populations. Mature, presumably viable, fruits were commonly observed in Wyoming populations in 1995. On average, pistillate plants were found to have 20 fruits per head and produce 10-12 heads per flowering stem.

#### G. POPULATION ECOLOGY

1. GENERAL SUMMARY: Antennaria arcuata occurs in hummocky or level subirrigated moist alluvial meadows in broad, gently sloping drainage bottoms surrounded by dry, upland big sagebrush grasslands. Individual plants are usually in small, dense, unisexual clusters in flats between and on the lower edges of hummocks where soils are moister or better shaded. Populations generally consist of equal proportions of staminate and pistillate plants.
2. COMPETITION: In Wyoming, Antennaria arcuata appears to decrease in areas with tall or dense vegetative cover. Colonies within BLM exclosures have been found to be in decline or locally extirpated where grazing has been prevented and vegetative cover has become notably denser and taller. High cover may also promote greater water retention in the soil, creating microsites that appear to be too wet for A. arcuata. Several Wyoming colonies have also been shown to decline

over time where shrubs have replaced graminoid vegetation.

A. arcuata is often found with A. microphylla in hummocky habitats in Wyoming. A. microphylla generally replaces A. arcuata on drier hummock tops and on wetter soils in communities associated with Nebraska sedge (Carex nebrascensis). Changes in soil moisture-retaining capacity, either through increased soil compaction or increased vegetation density, may shift the competitive balance in favor of A. microphylla at many sites.

3. HERBIVORY: A small percentage of flowering plants was observed to have broken stems and missing heads in 1995. This damage may be the result of herbivory or trampling by cattle or native grazers. Rosettes and lower stems showed no evidence of herbivory. Rodents, insects, and other small grazers may feed on fruits and inflorescences.
4. HYBRIDIZATION: Bayer (1992) reported the presence of allozyme markers normally associated only with Antennaria microphylla in A. arcuata specimens from Mormon Creek, Wyoming (EO # 004), suggesting possible hybridization or introgression between populations of these species at this site. Unlike polyploid species of Antennaria, hybridization appears to be uncommon among the diploid taxa of the genus (Cronquist 1994).

#### H. LAND OWNERSHIP

1. BUREAU OF LAND MANAGEMENT: All known Wyoming occurrences of Antennaria arcuata are found wholly or partly on lands managed by the BLM (Table 3). Seventeen populations are found in the Rawlins District (Lander Resource Area) and three are within the Rock Springs District (Green River Resource Area).
2. PRIVATE: Portions of eleven occurrences are known or strongly suspected to extend from BLM lands onto adjacent private or state lands. Part of one occurrence (EO # 007) is protected within The Nature Conservancy's Sweetwater River Preserve.

Table 3. Land management status of known occurrences of Antennaria arcuata in central Wyoming

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1. BLM Rawlins District (Lander Resource Area)

- \* Occurrence 001 (Burr Mine)
- Occurrence 003 (Granite Creek drainage)
- \* Occurrence 004 (Mormon Creek drainage)
- \* Occurrence 005 (Tributary of Willow Creek)
- Occurrence 006 (Long Slough)
- \* Occurrence 007 (Harris Slough) in part.
- \* Occurrence 009 (McLean Meadows)
- \* Occurrence 010 (Level Meadows Creek)
- Occurrence 011 (Upper Deep Creek)
- Occurrence 012 (Diamond Creek)
- Occurrence 013 (Upper Strawberry Creek)
- Occurrence 015 (The Crow's Nest)
- \* Occurrence 016 (Tributary of Rock Creek)
- \* Occurrence 019 (Tributary of Buffalo Creek)
- \* Occurrence 020 (East Fork East Long Creek)
- \* Occurrence 021 (Chimney Creek)
- Occurrence 023 (Willow Creek)

2. BLM Rock Springs District (Green River Resource Area)

- Occurrence 017 (Pine Creek)
- \* Occurrence 018 (Fish Creek)
- Occurrence 022 (Oregon Gulch drainage)

3. The Nature Conservancy

- Occurrence 007 (TNC Sweetwater River Preserve) in part.

\* Also known or suspected to occur on adjacent private or state lands.

#### IV. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

A. POTENTIAL THREATS TO CURRENTLY KNOWN POPULATIONS: The restricted and specialized habitat of Antennaria arcuata make this species vulnerable to habitat degradation and loss. The following potential threats have been reported in the literature or were identified in 1995 surveys:

1. GRAZING: Clark and Dorn (1979) and Whiskey Basin Consultants (1982) cited overgrazing of A. arcuata habitat as the most serious threat to the survival of this species. In late summer and fall, cattle congregate in the riparian bottomlands occupied by A. arcuata because of a lack of green forage and water in the adjacent uplands. While livestock appear not to preferentially graze this species, damage to flowering stems can result from trampling, especially when stock densities are high (Whiskey Basin Consultants 1982; Marriott 1986). Potential A. arcuata habitat where livestock are congregated (such as stock ponds or water tanks) have been observed to be completely denuded due to trampling and soil erosion.

Riparian meadows within the Sweetwater River Valley appear to have a long history of high grazing use. Bison were reported to be abundant in the Sweetwater Valley (Dorn 1986) and probably made heavy use of the wet meadows inhabited by A. arcuata (Bayer 1992). Early explorers often reported that large areas were completely denuded of grass cover as a result of bison grazing, resulting in a lack of forage for their horses and livestock (Dorn 1986). More lasting impacts may have come from the nearly 300,000 emigrants that passed through the valley on the Oregon Trail from 1840-1860. The riparian meadow habitats undoubtedly received higher grazing use by the pioneers horses and livestock than the surrounding upland sagebrush grasslands (Madson 1993). Many areas of potential or occupied habitat of A. arcuata may have been damaged at this time, long before current grazing practices were introduced into the area.

Under appropriate stocking rates, grazing may have some benefit to A. arcuata by keeping competing graminoid and shrub cover short. A. arcuata is most abundant in areas with lawn-like, low vegetation. Areas of suitable habitat within grazing exclosures have been observed to have much

denser and taller graminoid cover that appears to be unsuitable to A. arcuata.

2. RECREATION: Trampling by off-road vehicles and the proliferation of two-track roads are serious threats in many areas occupied by A. arcuata. Vehicle trampling can result in soil compaction, erosion, or changes in moisture retention at a site. A. arcuata plants were found to be extremely uncommon or absent in all but the least developed roadbeds in 1995.
3. MINERAL DEVELOPMENT: Past placer mining for gold in the South Pass City-Atlantic City area may have eliminated some populations of A. arcuata (Marriott 1986). Resumption of gold mining in this area could become a threat in the future (Marriott 1988). Uranium mining in the Jeffrey City area could also become a threat. Whiskey Basin Consultants (1982) recommended withdrawing known areas of A. arcuata habitat from mineral development.
4. OTHER: Construction of water reservoirs could eliminate A. arcuata populations in some drainages (Marriott 1986). Diversion of water or other actions altering the hydrologic regime of the small tributary drainages of the Sweetwater River are potential threats. Competition from exotic or native weed species is considered a potential threat in Idaho (Lorain 1990).

B. MANAGEMENT PRACTICES AND RESPONSE: At the recommendation of Whiskey Basin Consultants (1982), the BLM Lander Resource Area began a long-term monitoring study of the effects of grazing on Antennaria arcuata in 1983 (Marriott 1986). Two one-acre, livestock-proof exclosures were established on Willow Creek (EO # 004) and Diamond Creek (EO # 012) to determine plant production and frequency (Winnepenninkx 1984). Examination of these sites in 1995 revealed that no A. arcuata plants are currently present within these exclosures. Vegetation was observed to be denser and taller within the exclosures than immediately outside, where grazing by native and domestic animals is unimpeded. A. arcuata plants are still present in the lawn-like, grazed areas just outside of the exclosures. The population at Willow Creek has experienced a dramatic decrease in abundance since 1982, possibly as a result of habitat changes following the establishment of the exclosure (Table 2).

## C. CONSERVATION RECOMMENDATIONS

1. RECOMMENDATIONS REGARDING PRESENT OR ANTICIPATED ACTIVITIES: Although the chosen exclosure sites may not be representative of conditions at all sites (A. Warren, personal communication in Marriott, 1988), long-term BLM exclosure studies appear to indicate that removal of grazing may result in habitat changes that are detrimental to the continued existence of Antennaria arcuata. Contrary to the recommendations of Whiskey Basin Consultants (1982), additional exclosures should not be established to protect A. arcuata habitat. Existing exclosure studies may need to be modified to test whether reintroduction of grazing can facilitate recolonization of formerly occupied habitat. Demographic monitoring studies initiated in 1995 should be continued and expanded to include a broader range of habitats.

Livestock stocking rates should be carefully calculated to avoid overutilization or congregation of animals in wetland areas that could result in trampling damage. Water tanks and stock ponds should be located outside of riparian corridors to reduce trampling in more fragile habitats.

Development of wet meadow habitat on lands managed by the BLM needs to be carefully regulated to prevent damage to A. arcuata habitat from water development projects, road construction, recreational activity, and mineral development and exploration. Withdrawals should still be pursued for hard rock minerals within these riparian areas. No-surface-occupancy stipulations should be applied for oil, gas, and phosphate leases within occupied or high potential A. arcuata habitat (Marriott 1986).

2. NOTIFICATION OF BLM PERSONNEL OF LOCATIONS ON BLM LANDS: To prevent inadvertent impacts to known populations, all appropriate BLM personnel involved in planning and on-the-ground land management activities should be provided with location data for Antennaria arcuata. It is especially important that agency minerals, engineering, and range staff know precise locations so that disturbances can be avoided.
3. AREAS RECOMMENDED FOR PROTECTION: Only a portion of one occurrence (EO # 007, along Harris Slough)

is currently within an established special management area, owned by the Wyoming Nature Conservancy. Part of the McLean Meadows population (EO # 009) is within the Sweetwater Canyon Wilderness Study Area (Marriott 1986). Other large and healthy populations of A. arcuata along Granite Creek (EO # 003), Long Slough (EO # 006), and Strawberry Creek at the Crow's Nest (EO # 015) should be established as Areas of Critical Environmental Concern (ACECs) to protect its habitat. Current livestock management within these recommended ACECs does not need to be modified as long as it remains compatible with the needs of this species.

- D. STATUS RECOMMENDATIONS: Antennaria arcuata should be recognized as a "Species at Risk" and continue to receive the same management attention that it was formerly provided as a USFWS Category 2 candidate for listing under the Endangered Species Act. In the absence of a significant downward population trend, this species does not need to be considered for listing as a formal candidate for Threatened or Endangered status at this time.

The BLM Wyoming State Office should list A. arcuata as a state Sensitive species and develop appropriate management strategies to ensure that actions by the agency do not contribute to the further endangerment of this species and the subsequent need for listing under the Endangered Species Act. The BLM Rock Springs District should continue to manage this plant as a species of concern.

- E. SUMMARY: Antennaria arcuata is a regional endemic restricted to three disjunct areas of northeastern Nevada, south-central Idaho, and central Wyoming. It has been under consideration for listing as Threatened or Endangered since 1975. Rangewide, the species is known from 25-26 occurrences, 20 of which are found in Fremont County, Wyoming. These populations are almost entirely restricted to BLM lands within the Sweetwater River Valley and the southern foothills of the Wind River Range. A. arcuata is found primarily in subirrigated, alluvial meadows within broad drainage bottoms dominated by tufted hairgrass and Baltic rush. These sites are hummocky or flat and typically have short cover, which may be maintained by livestock or native grazing animals. In hummocky areas, A. arcuata is found primarily in flats between adjacent hummocks or on their lower edges, where it may form small, but dense clusters. This species is replaced by a related

taxon, A. microphylla, on drier hummock tops and in wetter areas. Wyoming surveys in 1995 found an estimated 99,000-130,000 individuals. Compared with estimates made in 1982, the total population appears to be stable to slightly decreasing. Exclosure studies suggest that this species can decline or be eliminated in habitats where graminoid cover becomes overly dense and soils become too mesic. The main real or potential threats to this species are trampling by congregated livestock and vehicles, water development, and disturbance associated with mineral development. Only one population currently receives special management attention. A. arcuata is recommended for protection as a "Species at Risk" by USFWS and for listing as Sensitive by the BLM.

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