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GAURA NEOMEXICANA Woot.
ssp. COLORADENSIS (Rydb.) Raven & Gregory

RECOVERY PLAN

Technical Review Draft
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APPROVED

Date: _____

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Director

DISCLAIMER

This is a Technical Review Draft Recovery Plan for Gaura neomexicana Woot. ssp. coloradensis (Rydb.) Raven & Gregory (Colorado butterfly plant). It is not an official government document and has not been approved by the U.S. Fish and Wildlife Service or any other agency. Although it does not necessarily represent official positions of the U.S. Fish and Wildlife Service or other agencies, this review has been prepared for the U.S. Fish and Wildlife Service to delineate actions required to protect the taxon. This proposal is subject to modification following review and receipt of comments by cooperating agencies and other informed, interested parties. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

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Part I. INTRODUCTION

History

The Colorado butterfly plant was first described by Rydberg (1904) as Gaura coloradensis from material collected near Ft. Collins, Colorado by J. H. Cowen on July 8, 1895 (NY; isotype, GH). Munz (1938) reduced the taxon to varietal status under G. neomexicana Wooton. It is now recognized as a subspecies of that taxon (Raven and Gregory 1972). It is segregated from the typical subspecies based on differences in pubescence and fruit morphology. G. neomexicana is characterized by disjunct distribution patterns (Fig. 1), with ssp. coloradensis and the typical subspecies perhaps representing, respectively, northern and southern relicts of a formerly more widespread taxon.

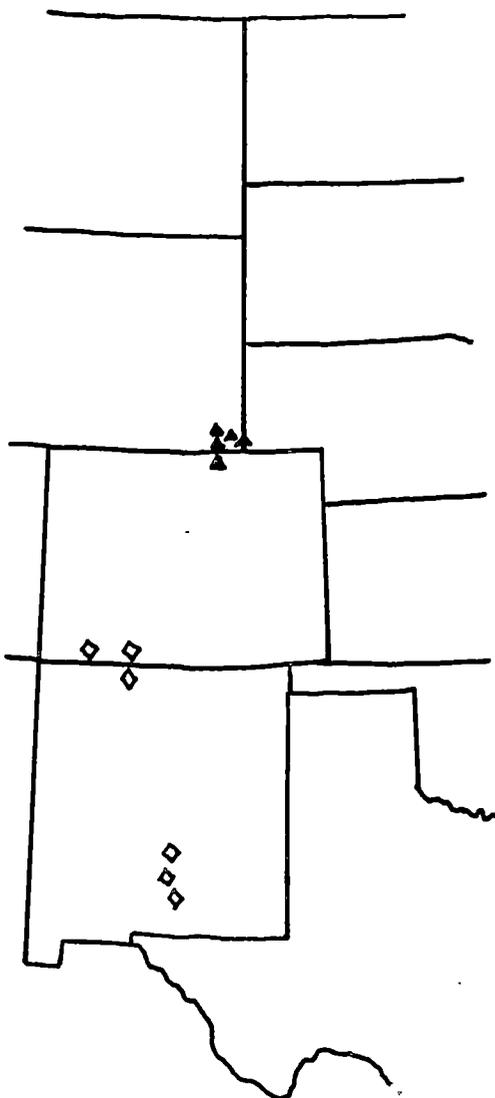
In a 1979 status report (R. Dorn), only three known populations of Gaura neomexicana ssp. coloradensis were reported: two in Laramie County, Wyoming, along Diamond Creek on and west of Warren Air Force Base (WAFB), and one along Lone Tree Creek in northern Weld County, Colorado. Two early collections, near Ft. Collins, Colorado, and near Pine Bluffs, Wyoming, had not been recently confirmed. Population numbers were 100, 6 and 1, respectively, suggesting that the taxon was extremely vulnerable. It was recommended to be listed as endangered on November 10, 1979 (Species Data Sheet, Wyoming Natural Heritage Program), but no such action has been undertaken. The taxon is currently a Category 1 candidate (USDI 1985).

Field work in 1981 showed that the population of Gaura neomexicana ssp. coloradensis on WAFB was significantly larger than previously thought. No 1981 population data are available; the WAFB occurrence was not systematically surveyed until 1986. In 1982, a management plan for the taxon was developed by the U.S. Fish and Wildlife Service (USFWS), the U.S. Air Force (USAF) and the Wyoming Natural Heritage Program (WNHP) (Appendix I) to prevent habitat destruction by herbicide spraying, mowing or grazing. This agreement has been renewed annually through the present (T. Wolf, pers. comm.).

In 1984, a three-year study of Gaura neomexicana ssp. coloradensis was initiated by the Rocky Mountain Heritage Task Force (RMHTF) of The Nature Conservancy. It was funded by the Department of Defense (DOD), USAF through the USFWS, Region 6. The purposes of the study were to determine more precisely the range and status of the taxon in Colorado, Wyoming and Nebraska, and to gather data concerning habitat requirements, reproduction and population trends using monitoring sites on WAFB.

Field inventory in northern Colorado in 1984 yielded two small occurrences of Gaura neomexicana ssp. coloradensis in northern Weld County along Lone Tree Creek near the Wyoming-Colorado State line.

Fig. 1. Rangewide distribution of subspecies of Gaura neomexicana ssp. coloradensis (after Munz 1938 in part).



- ◊ Gaura neomexicana ssp. neomexicana
- ▲ Gaura neomexicana ssp. coloradensis

Twenty occurrences are now known from Wyoming, all in Laramie County. One extends a short distance into western Kimball County, Nebraska. These sites were surveyed in 1984 through 1986. Occurrence data are included in Appendix II.

Description

Technical description:

Biennial (or perennial?) herb, from thick root; stems one to several from the base, erect, simple or few-branched above, 5-8 dm high, greenish or reddish, pubescent; basal leaves 8-15 cm long, the blades oblanceolate, subentire or sinuate-denticulate, pubescent, 4-7 cm long, 1-2 cm wide, narrowed into almost equally long winged petioles; cauline leaves mostly lanceolate, 5-10 cm long, 8-16 mm wide, strigose, acute, subentire to minutely sinuate-denticulate, gradually narrowed into short winged petioles; upper ones reduced, subsessile; floral bracts lanceolate, pubescent, cuminuate, 5-8 mm long, caducous; inflorescence spicate, simple or few-branched, 1-4 dm long in fruit; hypanthium slender, 8-12 mm long, pubescent without, with a white matted curly pubescence within; sepals more or less red, reflexed separately in anthesis, linear-lanceolate, 9.5-13 mm long, 1.5-2 mm wide; petals pink-white, short-clawed, spatulate to narrowly obovate, 8-10 mm long; stamens subequal, filaments slightly enlarged upward, about as long as petals; with minute thickened basal scale; anthers linear, 3-4 mm long; style 19-25 mm long, pubescent at very base; stigma-lobes surpassing the indusium 1-1.5 mm; capsule 6-8.5 mm long, 2-3 mm thick, fusiform, obtusely 4-angled and with a median nerve on each face, apparently 1-seeded. Self-compatible. Gametic chromosome number $n = 7$. (Munz 1938, Raven and Gregory 1972.)

Non-technical description:

Typically, the Colorado butterfly plant is a relatively tall (5 to 8 dm) herbaceous biennial plant with one or a few reddish stems that branch above mid-height. Leaves on mature plants are few. They are lance-shaped and 5 to 10 cm long, becoming smaller higher on the plant. The first-year rosettes are made up of larger leaves, up to 15 cm long. Flowering branches elongate as the season progresses. At the tips are flat-topped clusters of buds. Generally, a few flowers are located below the buds and above what fruits have already matured. Flowers are white to pink with four distinct petals, and are 1 to 1.5 cm across. The fruits are small (6 to 8.5 mm) and usually 4-angled.

Gaura neomexicana ssp. coloradensis differs from the typical subspecies in pubescence and fruit size. The typical subspecies is characterized by villous and strigulose stems and fruits 8.5-11 mm long and 4.5 mm thick. The stems of Colorado butterfly plant are strigulose only, and the fruits are smaller (6-8.5 mm long, 2-3 mm thick). Descriptions and taxonomic decisions have been based on only six collections from four localities: near Cheyenne and Pine Bluffs, Laramie County, Wyoming, Ft. Collins, Larimer County, Colorado, and Natural Fort, Weld County, Colorado.

In the field, the taxon could be confused with Gaura parviflora, which often occurs nearby, though generally on slightly drier sites. G. neomexicana ssp. coloradensis is relatively tall (to 1.5 m, but usually less than 1 m) with few-leaved reddish to very red stems that generally branch only in the inflorescence. It is less robust and branched than G. parviflora. Flowers are few per branch, occurring near the tips, and are white to pale pink. They are much larger than those of G. parviflora. In addition, buds of Colorado butterfly plant are arranged in flat-topped clusters while those of G. parviflora are obviously racemose. Pubescence can also be used to separate the taxa as the leaves of G. parviflora are much more pubescent and feel fuzzy to the touch.

Past and Present Distribution

Little is known concerning the past distribution of Gaura neomexicana ssp. coloradensis, as no extensive documentation of its range had been done prior to this project. No sites in or near Ft. Collins, Larimer County, Colorado, the type locality, have been found since 1897. The taxon was collected at other sites in Larimer County in 1895 (east of Poudre) and 1944 (30 miles north of Ft. Collins), but at the present time, only two small populations are known from Colorado, both along Lone Tree Creek close to the Wyoming State line. Potential habitat in Weld and Larimer Counties was searched for Colorado butterfly plant occurrences in 1984.

Historic collections in Wyoming include one from Pine Bluffs in southeastern Laramie County in 1889 and several from Diamond Creek west of Cheyenne in 1977 through 1981. Twenty occurrences are now known from Laramie County; one continues a short distance into western Kimball County, Nebraska. Occurrence data are included in Appendix II and are summarized in Table A. The taxon's known range extends from the upper Bear Creek drainage in northwest Laramie County, Wyoming, south to Lone Tree Creek in northern Weld County, Colorado, and east along Lodgepole Creek in Laramie County to several miles beyond the Wyoming-Nebraska State line near Pine Bluffs (Fig. 2). Some unsurveyed potential habitat remains in northern Laramie and southern Platte Counties, Wyoming, in the upper Bear Creek drainage (up and downstream from Occurrence Nos. 02-05) and along Spring Creek which flows north into Chugwater Creek.

Table A. Gaura neomexicana ssp. coloradensis occurrence data.

<u>Occurrence No.</u>	<u>No. Adult Plants</u>	<u>Management Responsibility</u>
WYOMING:		
01	604 (1985)	Vowers Ranch Inc.; J. H. Paul; State of Wyoming
02	1447 (1986)	True Ranches Inc.
03	674 (1986)	True Ranches Inc.
04	28 (1986)	True Ranches Inc.
05	10 (1986)	True Ranches Inc.
06	898 (1986)	True Ranches Inc.
07	less than 35 (1984)	Nimmo Ranch Co.
08	660 (1984,85)	Nimmo Ranch Co.; True Ranches Inc.
09 (in NEBRASKA in part)	2065 (1985)	C. Sundin; Gross-Wilkinson Ranch; N. L. Eastman; J. W. Hockersmith; Vowers & Sons Inc.
10	4503 (1985)	A. O. Paulus; A. Risha; R. W. Steege; J. H. Harer; R. W. Humphrey; E. S. Sorenson; G. L. Louth
11	389 (1985)	L. W. Inc.
12	80 (1985)	R. O. Dolan (Trustee)
13	255 (1984-86)	T. Simola; Oppenheimer Ind. Inc.
14	1262 (1986)	S. Tuck; L. Goertz
15	5564 (1986)	DOD, WAFB
16	565 (1986)	DOD, WAFB
17	930 (1985,86)	Wyoming Angus Ranch; G. A. King; Rolling Hills Estates (housing subdivision)
18	8 (1986)	Rees Ranch
19	less than 100 (1984)	Duck Creek Grazing Assoc.; Belvoir Grazing Assoc.
20	42 (1984)	Belvoir Grazing Assoc.
NEBRASKA: see WYOMING 09		
COLORADO:		
21	202 (1984)	private; State of Colorado
22	30 (1984)	private; State of Colorado

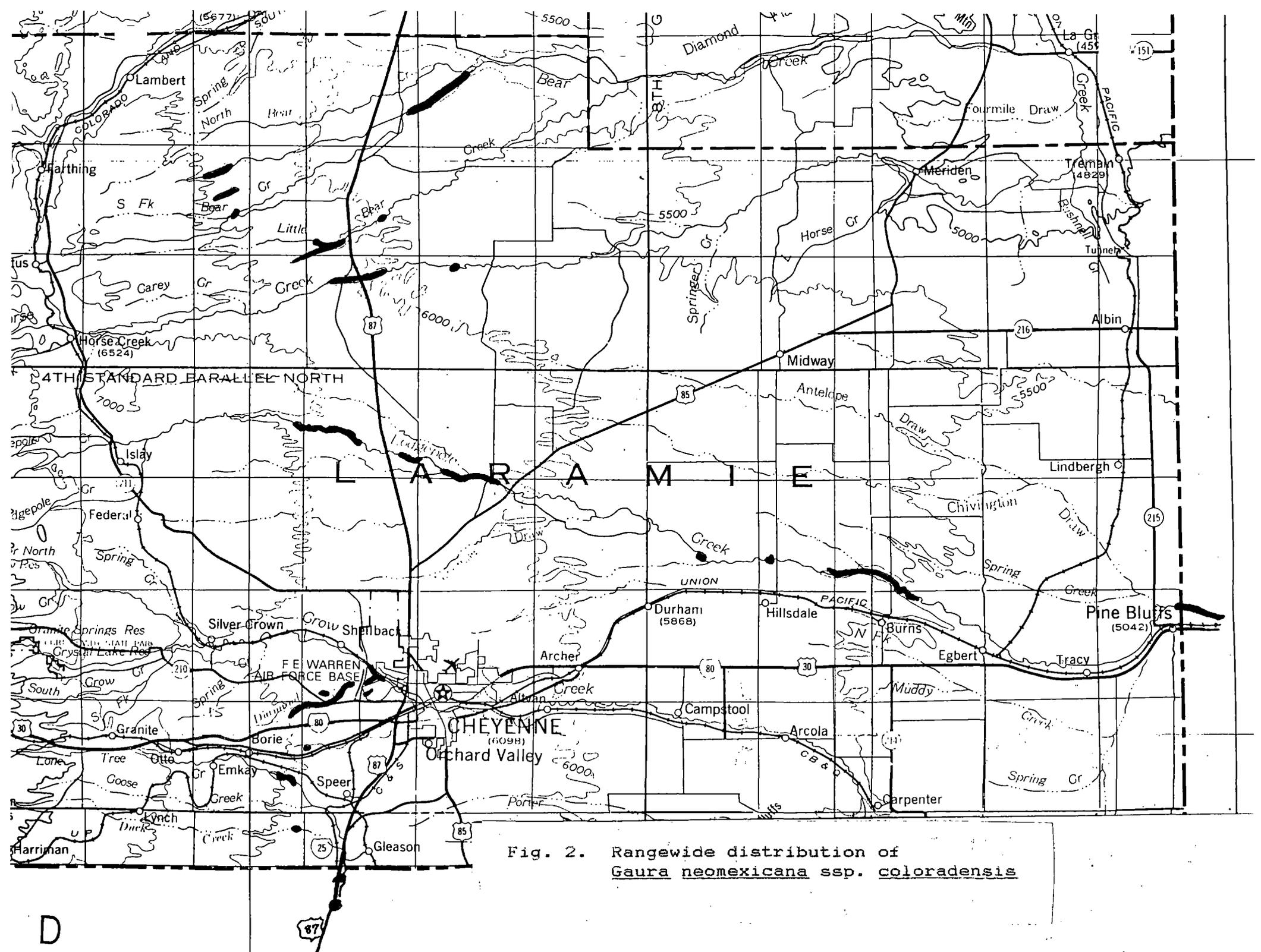


Fig. 2. Rangewide distribution of *Gaura neomexicana* ssp. *coloradensis*

Habitat and Biology

Gaura neomexicana ssp. coloradensis is found most commonly in moist meadows and on streambanks in broad prairie drainages from 5000 to 6400 ft above sea level (asl). It occurs on sites less mesic than those occupied by Carex-Juncus (sedge-rush) communities, but more mesic than the adjacent mixed-grass prairie (Fig. 3). This suggests that the taxon has fairly strict moisture requirements and may require shallow subsurface water. Habitat substrate is alluvium derived from conglomerates, sandstones, and tuffaceous mud- and siltstones of the Tertiary White River, Arikaree (rarely) and Oglalla (most commonly) Formations (Love and Christiansen 1985).

Average annual precipitation for Colorado butterfly plant habitat is in the range of 13-16 inches. The majority falls as rain from April through September. Rainfall peaks in May in the western part of the taxon's range. Moving east, summer precipitation becomes increasingly important; rainfall peaks in July in Pine Bluffs on the Wyoming-Nebraska State line. The Cheyenne and Pine Bluffs areas experience 190 and 180 frost-free days per year, respectively (Martner, in press). Growing seasons are probably shorter in the northern part of the taxon's range (no data available).

Disturbance appears to be a habitat requirement. Colonies of Colorado butterfly plant are best developed on otherwise sparsely vegetated sites, although the taxon does not occur on recently disturbed soil. Apparently it is not an initial colonizer, but moves in later in the successional sequence. Given the drainage bottom habitat, periodic flooding probably is the most important natural factor in habitat maintenance. Permanent plot data from WAFB suggest a significant decrease in population from 1984 to 1986 (down 39 percent), perhaps due to succession in the streamside vegetation. Photographic documentation suggests a similar trend. However, three years of monitoring is not sufficient to accurately assess vegetation trends in a biennial such as Gaura neomexicana ssp. coloradensis.

Gaura neomexicana ssp. coloradensis is a biennial (possibly a short-lived perennial) whose population numbers are thought to fluctuate widely from year to year, probably based on seed production, dispersal and habitat availability. No long-term studies have been done to monitor population trends. In 1984, the RMHTF established permanent plots at three sites on WAFB; they were monitored in 1985 and 1986. The data suggest that survival rates from basal rosette to flowering adult are somewhat low (26-44 percent during three years of monitoring). The WAFB populations are characterized by small to large patches of flowering adult plants (up to several hundred individuals) and numerous basal rosettes, interspersed with scattered individual plants. This within-site distribution pattern is seen throughout the taxon's range where populations are sufficiently large. Monitoring of Base populations indicates that within-site distribution of individuals of Colorado butterfly plant changes with time, probably in response to habitat availability.

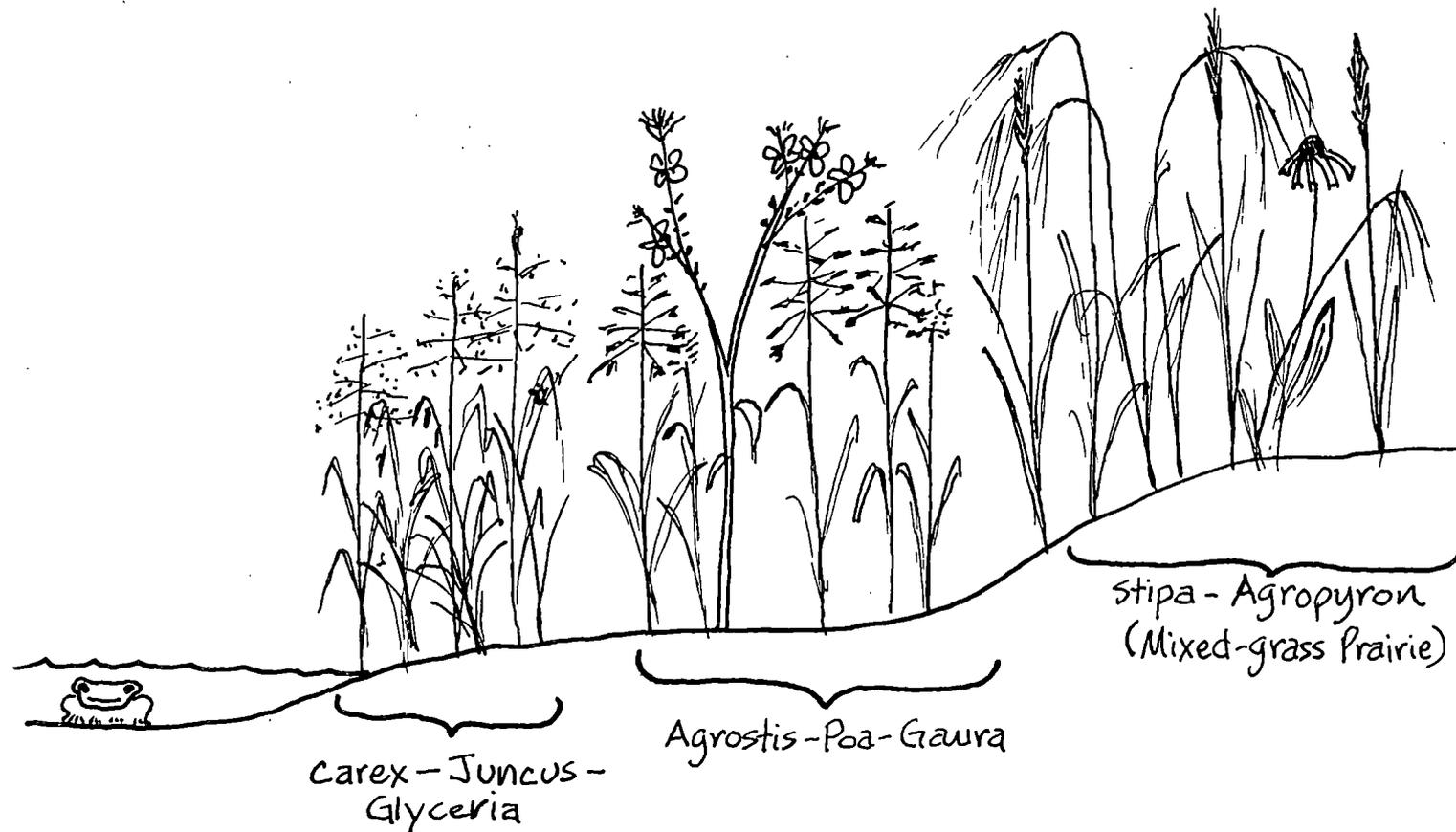


Fig. 3. Position of Gaura neomexicana ssp. coloradensis on the habitat moisture gradient

Studies of Gaura neomexicana ssp. coloradensis under cultivation at the University of Wyoming Botany Greenhouse suggest that cold winter temperatures may play an important role in determining the taxon's habit and survival. Under greenhouse conditions, Colorado butterfly plant is perennial, flowering every year (individuals planted in 1982-83 were still alive at the time of this report). Rosettes which receive cold treatment show a much lower survival rate to flowering adult than do untreated individuals (W. Higgins, pers. comm.).

Threats

Nineteen of the twenty-one known occurrences of Colorado butterfly plant are on private land. Land use at this time is almost entirely for agriculture, mainly haying and grazing (cattle and horses). Because owners and managers were contacted during the inventory, many are aware that they have a plant of interest on their property. However, very little information on the value of Colorado butterfly plant and protective measures has been disseminated. In addition, the present lack of knowledge concerning the taxon's biology, ecology and population trends makes it difficult to recommend beneficial management practices.

Land uses by occurrence are included on the data forms in Appendix II. The following list summarizes potential threats to Gaura neomexicana ssp. coloradensis:

1. Herbicide spraying
2. Livestock and/or wildlife overgrazing
3. Livestock trampling/trailing
4. Mowing (hay)
5. Water development (reservoirs, stockponds, etc.)
6. Land conversion for cultivation
7. Road and facilities construction on WAFB

Spraying herbicide for control of Canada thistle (Cirsium arvense) and leafy spurge (Euphorbia esula) is the most obvious threat at this time. These two species, listed as noxious in Laramie County, commonly occur in Gaura habitat. The habitat is often heavily used by livestock, which tend to concentrate near water sources. In two situations of adjacent pastures (within Occurrence Nos. 02 and 03), the more heavily grazed pastures supported far fewer individuals of Colorado butterfly plant. Some grazing is probably tolerable, but no information is available concerning proper stocking levels. On WAFB, where no livestock is present, plants have been heavily browsed in some areas, probably by deer or pronghorn.

Many Gaura occurrences are located on the margins of hayfields (near streams), and may have been more extensive at one time. The response of individual plants to mowing is not known. Construction of stockponds and reservoirs within Gaura habitat would destroy more habitat than it would create, due to the taxon's specific moisture

requirements (it is generally found on level to gently sloping sites near but not immediately adjacent to streams, probably in areas of shallow subsurface water). Although none of the known occurrences are farmed at present, land conversion of Colorado butterfly plant habitat for cultivation is a potential threat.

The largest known occurrence is located on WAFB. In 1982, a management plan for the taxon was agreed upon by the USFWS, the USAF and the WNHP. The plan, which has been automatically renewed annually through the present time (T. Wolf, pers. comm.), prohibits herbicide spraying, livestock grazing and mowing within Gaura neomexicana ssp. coloradensis habitat. Road construction (upgrading existing routes) has recently encroached on known habitat along Diamond Creek after consultation indicated that the impact on the population as a whole would be insignificant (R. Dorn, pers. correspondence, WAFB files).

Because so much of the taxon's known range is privately owned, it is important for its survival that landowners and managers be aware of its existence, status and needs. At this time, little has been done to promote public awareness of Colorado butterfly plant and the threats to its continued existence. In addition, land use planning is hampered by the present lack of knowledge concerning the taxon's biology, ecology and population trends. Long-term study is needed.

Part II. RECOVERY

Objective

To ensure the survival of Gaura neomexicana ssp. coloradensis in the face of ongoing habitat threats as well as unforeseen localized catastrophic events, the objective of the recovery plan is to concentrate efforts on the recovery and maintenance of eight occurrences of several thousand flowering individuals each, the sites to be scattered throughout the taxon's range. The objective also includes application of protective and recovery measures to all known occurrences whenever resources allow.

Step-Down Outline

1. Disseminate information on the known occurrences and potential occurrences of Gaura neomexicana ssp. coloradensis, and Endangered Species Act (ESA) responsibilities.
 - 1.1. Inform the DOD, USAF, of precise occurrences on WAFB.
 - 1.2. Incorporate occurrence information into DOD, WAFB, planning and decision-making processes.
 - 1.3. Inform private landowners having occurrences on their lands of the importance of those sites.

- 1.4. Inform State agencies of the known occurrences and areas of potential habitat.
 - 1.5. Inform the Corps of Engineers (US Army, DOD) and the Soil Conservation Service of known occurrences and areas of potential habitat.
 - 1.6. Inform relevant interested parties of recovery efforts to encourage assistance.
2. Implement conservation strategies for the perpetuation of the essential habitat and the taxon.
 - 2.1. Hold Recovery Committee Meeting to initiate recovery plan, discuss funding and delegate responsibilities.
 - 2.2. Develop a Habitat Management Plan (HMP) for a Proposed Colorado Butterfly Plant Research Natural Area (RNA) administered by the DOD on WAFB.
 - 2.3. Provide review and input into the Habitat Management Plan for Colorado butterfly plant.
 - 2.4. Establish precise boundaries of critical habitat on eight widely dispersed occurrences with large populations of Gaura neomexicana ssp. coloradensis.
 - 2.5. Establish State registry programs for significant natural areas in Wyoming, Colorado and Nebraska, and encourage registry of known Colorado butterfly plant habitat.
 - 2.6. Federal agencies should continue to work with private land conservation organizations to implement habitat protection and conservation measures in the absence of Federal funding for recovery plans for plants.
 3. Develop dependable communications channels to assist in the perpetuation of the taxon and critical habitat on WAFB.
 - 3.1. Arrange for periodic visits to known occurrences on WAFB by Base personnel.
 - 3.2. Provide consultation for Base personnel involved in noxious weed eradication programs.
 4. Continue scientific research on known and potential habitat and the biology of the taxon.
 - 4.1. Conduct field inventory in remaining areas of unsurveyed Colorado butterfly plant potential habitat.
 - 4.2. Establish monitoring program for the eight occurrences

selected for concentrated recovery efforts (see 2.4.).

- 4.3 Establish monitoring program for potential habitat adjacent to the eight selected occurrences to better understand population dynamics and critical habitat.
- 4.4. Initiate a long-term study of the impact of livestock grazing on the taxon.
- 4.5. Collect seed from the taxon for deposit in the US Department of Agriculture (USDA) National Seed Laboratory, Ft. Collins, Colorado, and for cultivation at the Center for Plant Conservation, University of Nebraska Statewide Arboretum. Maintain greenhouse population at the University of Wyoming, Department of Botany Greenhouse.
- 4.6. Encourage research on aspects of Gaura neomexicana ssp. coloradensis biology relevant to recovery efforts.
5. Publicize as appropriate the value of Gaura neomexicana ssp. coloradensis and the recovery effort.
 - 5.1. Provide news releases and brochures addressing the Colorado butterfly plant and recovery efforts.
 - 5.2. Encourage other public institutions and organizations to publicize the taxon for educational and conservation purposes.
6. Encourage habitat acquisition/conservation easements by private land conservation organizations.

Narrative

1. Disseminate information on the known occurrences and potential occurrences of Gaura neomexicana ssp. coloradensis, and ESA responsibilities.
 - 1.1. Inform the DOD, USAF of precise occurrences of Gaura neomexicana ssp. coloradensis on WAFB. It should be the responsibility of the USFWS, Office of Endangered Species, to provide the appropriate personnel on WAFB with updated information as available.
 - 1.2. Incorporate occurrence information into DOD, WAFB, planning and decision-making processes. Gaura neomexicana ssp. coloradensis occurrence and habitat data should be an integral part of all planning documents applicable to the Crow Creek-Diamond Creek areas on the Base so that the taxon will receive due consideration in management decisions.

- 1.3. Inform private landowners having occurrences on their lands of the importance of those sites. Because most of the known Colorado butterfly plant habitat is privately owned, this step is very important. Information on proper land use for maintenance of the taxon and its habitat should be provided as it becomes available.
- 1.4. Inform State agencies of the known occurrences and areas of potential habitat, so that projects are planned to avoid habitat disruption. Relevant agencies include:

Wyoming: Department of Environmental Quality
Wyoming Highway Department
Department of Agriculture, Weed and Pest
Division

Nebraska: Department of Environmental Control
Natural Resources Commission
Department of Roads

Colorado: Colorado Natural Areas Program
Colorado Department of Highways

- 1.5 Inform the Corps of Engineers (US Army, DOD) and the Soil Conservation Service of known occurrences and potential habitat. The habitat meets the criteria of the Corps of Engineers (US Army, DOD) for "waters of the United States" (DOD 1986), and under Section 404 of the Clean Water Act, the Corps has permitting responsibility for fill activities if such activities jeopardize a threatened or endangered species as identified under the ESA. Examples are utility line crossings, bank stabilization, road crossings and other projects involving dredged or fill material discharge.

Technical advice and Federal cost share funds are available through the Great Plains Conservation Program of the Soil Conservation Service (SCS), and the Agricultural Conservation Program of the Agriculture Stabilization and Conservation Service, for soil conservation, water conservation, and range condition improvement projects on private land in Laramie Co., Wyoming. Federally-supported projects that could affect Colorado butterfly plant habitat include small water impoundments (for improved grazing distribution). Cost share funds for water development also are available under PL566 through the SCS. PL566 covers larger projects, such as flood control. Herbicide spraying programs are eligible for Federal cost share funding through the SCS if the program is directed towards range condition improvement. In Laramie Co., most of the herbicide programs funded at the present time are

for upland sites (J. Forster, pers. comm.).

- 1.6. Inform relevant interested parties of recovery efforts to encourage assistance. The Wyoming Native Plant Society was established in part to promote the conservation of native Wyoming plants by educational programs and research. Faculty, staff and students of the University of Wyoming, Depts. of Botany and Plant Science, should be encouraged to participate in Gaura inventory and research projects. The University of Nebraska Statewide Arboretum, a participating institution with the Center for Plant Conservation, should be informed of recovery efforts and could provide additional greenhouse and educational assistance.
2. Implement conservation strategies for the perpetuation of critical habitat and the taxon.
 - 2.1. Hold recovery Committee meeting to initiate recovery plan, discuss funding and delegate responsibilities. The membership of the Committee should represent the agencies and individuals concerned with the long-term perpetuation of Gaura neomexicana ssp. coloradensis.
 - 2.2. Develop a Habitat Management Plan (HMP) for a Proposed Colorado Butterfly Plant RNA administered by the DOD on WAFB. The RNA should be managed for the recovery and maintenance of the taxon and its habitat. Alternatives regarding types and varying degrees of management, as well as management responsibilities would be evaluated, and a Preferred Alternative adopted.

Recommended actions include the withdrawal of the Area from mowing and herbicide spraying programs, fence construction if Base land is opened to livestock grazing, maintenance of stream levels and water quality to ensure habitat suitability, no construction or other surface disturbance within the Area, establishment of population and habitat monitoring programs, and encouragement of use of the Area for educational and research purposes.
 - 2.3. Provide review and input into the Habitat Management Plan for Colorado butterfly plant. It should be the responsibility of the USFWS to participate and review the HMP.
 - 2.4. Establish precise boundaries of critical habitat on eight widely-dispersed occurrences with large populations of Gaura neomexicana ssp. coloradensis. While all known occurrences and potential habitat should be considered in recovery planning and actions, financial and other resource constraints dictate that efforts be concentrated on those occurrences that provide the greatest potential

for the long-term perpetuation of the taxon. Knowledge available at this time suggests that the most valuable occurrences are those with large areas of known and potential habitat, and large numbers of Colorado butterfly plants, including both flowering individuals and basal rosettes. In addition, target occurrences should be scattered throughout the range of the taxon, to increase the potential for range expansion through (re)colonization of unoccupied habitat, rather than being concentrated in a small area of the known range.

The populations and habitat on Crow and Diamond Creeks on WAFB constitute the highest priority occurrence, both because of size (over 5000 individuals present in 1986), and because the site is on Federal land and therefore subject to protection under the ESA if the taxon is listed. Conservation site summaries for three high-quality, widely-dispersed occurrences on private land are included in Appendix III.

Preservation of occurrences dispersed throughout the known range of the taxon is necessary to insure survival in the case of an unforeseen localized catastrophic event. At this time, there are seven known occurrences of Colorado butterfly plant that contained over 800 flowering individuals when last surveyed (1984-1986) scattered throughout Laramie County, Wyoming, and extreme western Kimball County, Nebraska. Critical habitat for known occurrences was defined in the 1986 status report for the taxon compiled by the RMHTF; boundaries for these occurrences are shown on 7 1/2' topographic maps in Appendix II of this report. For the eight occurrences selected for concentrated recovery efforts, critical habitat needs to be more precisely delimited, and modified as more information becomes available concerning population dynamics and habitat requirements.

- 2.5. Establish State registry programs for significant natural areas in Wyoming, Colorado and Nebraska, and encourage registry of known Colorado butterfly plant habitat. Most known habitat is privately owned and beyond the jurisdiction of the ESA. As a result, there is a great need for public awareness and appreciation of Colorado butterfly plant and its continued survival. Registry programs currently exist in twenty-two States, and have proven to be relatively simple, cost-effective, low-keyed approaches to habitat protection. Registry often serves as the first step towards more long-term conservation measures.
- 2.6. Federal agencies should continue to work with private land conservation organizations to implement habitat protection

and conservation measures in the absence of Federal funding for recovery plans for plants. Cooperative Management Agreements involving the USFWS, the USAF, The Nature Conservancy and the Wyoming Native Plant Society could be drawn up for monitoring and study of Gaura neomexicana ssp. coloradensis habitat on WAFB, for providing expertise in development of a Colorado Butterfly Plant RNA and HMP, and for consultation concerning eradication of noxious weeds within Gaura habitat. The Wyoming Native Plant Society should be encouraged to participate in survey and monitoring activities. Registry of privately owned sites could be the responsibility of The Nature Conservancy Land Owner Contact Program. The Center for Plant Conservation should be provided with updated information for their educational programs.

3. Develop dependable communications channels to assist in the perpetuation of the taxon and critical habitat on WAFB.
 - 3.1. Arrange for periodic visits to known occurrences on WAFB by Base personnel accompanied by individuals knowledgeable concerning the taxon and its habitat. The staff should be kept aware of the existence of Gaura neomexicana ssp. coloradensis on the Base, the value of the Base occurrence (it is the largest known occurrence and the only one on Federal land and therefore within the protection of the ESA if the taxon were listed), and what constitutes maintenance of critical habitat.
 - 3.2. Provide consultation for Base personnel involved in noxious weed eradication programs. It is important that populations and habitat of Colorado butterfly plant are not inadvertently sprayed with herbicide or mowed.
4. Continue scientific research on known and potential habitat and the biology of the taxon.
 - 4.1. Conduct field inventory in remaining areas of unsurveyed Colorado butterfly plant potential habitat. A small amount of unsurveyed potential habitat remains in northern Laramie and southern Platte Counties. Specifically, survey of the upper Bear Creek drainage needs to be completed. Occurrence Nos. 02, 03 and 05 extend unknown distances beyond surveyed boundaries. Although the North Fork Bear Creek contained no habitat where surveyed, populations may exist further up- or downstream. Spring Creek, which flows north from Laramie County into Chugwater Creek in Platte County may include Colorado butterfly plant habitat where the Oglalia Formation is at the surface. All unsurveyed portions of Lodgepole Creek from Interstate 25 east to Pine Bluffs should be checked for occurrences as populations are known from sites scattered

throughout this section of drainage.

- 4.2. Establish monitoring program for the eight occurrences selected for concentrated recovery efforts (see 2.4.). Because population numbers fluctuate widely from year to year, long-term monitoring is needed to determine overall population trends. Plot size must be sufficiently large to overcome artifacts resulting from the continually shifting patchy within-site distribution pattern characteristic of Colorado butterfly plant.
- 4.3. Establish monitoring program for potential habitat adjacent to the eight selected occurrences to better understand population dynamics and critical habitat. The apparent requirement for disturbance in Gaura neomexicana ssp. coloradensis habitat suggests that occurrences move as habitat availability changes. This pattern of population dynamics requires critical habitat extending perhaps far beyond areas presently occupied by the taxon. Therefore, plots should be established in unoccupied drainage areas up- and downstream from known occurrences.
- 4.4. Initiate a long-term study of the impact of livestock grazing on the taxon. Much of the known habitat is privately owned and grazed by cattle and/or horses. Heavy grazing appears to have an adverse effect on populations of Colorado butterfly plant (see discussion under Threats). Although private landowners are not legally bound to manage Colorado butterfly plant sites for taxon, even if it were listed, advice concerning stocking levels might be of use in connection with registry (see 2.5.).
- 4.5. Collect seed from the taxon for deposit in the USDA National Seed Laboratory, Ft. Collins, Colorado, and for cultivation at the Center for Plant Conservation, University of Nebraska Statewide Arboretum. Maintain greenhouse population at the University of Wyoming, Department of Botany Greenhouse. Seed sources should be scattered throughout the range of the taxon to provide a diversity of genetic material for recovery in the event of loss of all major occurrences.
- 4.6. Encourage research on aspects of Gaura neomexicana ssp. coloradensis biology relevant to recovery efforts. Topics include:

- Mechanisms of seed dispersal
- Germination rates and requirements
- Seedling establishment, survival and ecology
- Pollination ecology and importance of outcrossing
- Role of disturbance in habitat maintenance

5. Publicize as appropriate the value of Gaura neomexicana ssp. coloradensis and the recovery effort.
 - 5.1. Provide news releases and brochures addressing the Colorado butterfly plant and recovery efforts. Because the vast majority of known habitat is privately owned and beyond the jurisdiction of the ESA, efforts to increase public awareness and appreciation of the taxon and its long-term survival are very important.
 - 5.2. Encourage other public institutions and organizations to publicize the taxon for educational and conservation purposes. Such organizations include The Nature Conservancy, the Wyoming Native Plant Society, the Colorado Native Plant Society and the Center for Plant Conservation.
6. Encourage habitat acquisition/conservation easements by private land conservation organizations. Only two occurrences of Gaura neomexicana ssp. coloradensis are located on Federally-owned land, and would be clearly protected by the ESA if listed. As a result, the protection of privately owned habitat through conservation easements or direct acquisition is essential for better insuring long-term survival of Colorado butterfly plant. Conservation site summaries for three high-quality, widely-dispersed occurrences on private land are included in Appendix III.

Part III. IMPLEMENTATION SCHEDULE

Task Number	Task	Priority	Duration	Responsible Agency
1.1.	Inform USAF of precise occurrences	A	Periodic	USFWS, Reg. 6
1.2.	Incorporate data into WAFB planning	A	Periodic	DOD, USAF
1.3.	Inform private landowners	A	Periodic	USFWS, Reg. 6
1.4.	Inform State agencies of occurrences	A	Periodic	USFWS, Reg. 6
1.5.	Inform Corps of Engineers, SCS of occurrences	A	Periodic	USFWS, Reg. 6
1.6.	Inform relevant interested parties of recovery efforts	A	Periodic	USFWS, Reg. 6
2.1.	Recovery Committee meeting	A	Once	USFWS, Reg. 6
2.2.	Develop WAFB Habitat Management Plan	A	Once	DOD, USAF
2.3.	Provide review, input for WAFB HMP	A	Once	USFWS, Reg. 6
2.4.	Establish critical habitat for target occurrences	B	Once	USFWS, Reg. 6
2.5.	Develop State registries and register Colorado butterfly plant occurrences	B	Once	
2.6.	Cooperate with private land conservation efforts	B	Ongoing	USFWS, Reg. 6
3.1.	Periodic visits to WAFB occurrences by Base personnel	A	Periodic	USFWS, Reg. 6; DOD, USAF
3.2.	Provide consultation for WAFB weed eradication programs	A	Periodic	USFWS, Reg. 6; DOD, USAF
4.1.	Field surveys	B	One season	USFWS, Reg. 6
4.2.	Monitor target occurrences	B	Periodic	USFWS, Reg. 6
4.3.	Monitor potential habitat adjacent to target occurrences	C	Periodic	USFWS, Reg. 6
4.4.	Initiate grazing studies	C	20-30 yrs	USFWS, Reg. 6
4.5.	Collect seed	C	Once	USFWS, Reg. 6
4.6.	Encourage research	C	Ongoing	USFWS, Reg. 6
5.1.	Provide news releases	C	Periodic	USFWS, Reg. 6
5.2.	Cooperate with public institutions	C	Ongoing	USFWS, Reg. 6
6.	Encourage habitat acquisition by private land conservation organizations	B	Ongoing	USFWS, Reg. 6

LITERATURE CITED

Love, J. D. and A. C. Christiansen. 1985. Geologic Map of Wyoming. U.S. Geol. Survey.

Martner, B. In press. Climatic Atlas of Wyoming.

Munz, P. A. 1938. Studies in Onagraceae XI. A revision of the genus Gaura. Bull. Torrey Bot. Club 65:113-114.

Raven, P. H. and D. P. Gregory. 1972. A revision of the genus Gaura (Onagraceae). Mem. Torrey Bot. Club 23:1-96.

Rydberg, P. A. 1904. Bull. Torrey Bot. Club 31:572.

USDI, U.S. Fish and Wildlife Service. 1985. Endangered and Threatened wildlife and plants; review of plant taxa for listing as Endangered or Threatened Species; Notice of Review. FR 50(188): 39525-39584.