CHAIN LAKES BOTANICAL SURVEY

Sweetwater County, Wyoming

Prepared for:
Bureau of Land Management
Rawlins Field Office

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ABSTRACT

Systematic survey was conducted for many-stemmed spider-flower (*Cleome multicaulis*) in the playa vegetation of Chain Lakes Wildlife Habitat Management Area. Many-stemmed spider-flower was not found, but four other Wyoming plant species of concern were documented. Meadow milkvetch (*Astragalus diversifolius*) was rediscovered in Wyoming, pale blue-eyed grass (*Sisyrinchium pallidum*) was documented as a new county record, and new occurrence records for two Great Basin annuals, red poverty-weed (*Monolepis pusilla*) and tiny phacelia (*Phacelia tetramera*) were added. Preliminary documentation of the flora and description of the vegetation was also compiled.

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Cover: Chain Lakes playa vegetation landscape; as seen from a mound providing habitat for *Monolepis pusilla* (foreground). Photo by B. Heidel.

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INTRODUCTION

The Chain Lakes Wildlife Habitat Management Area contains a series of alkaline lakes and other wetlands in a closed-drainage system. Baseline botanical documentation was initiated to determine whether many-stemmed spider-flower (*Cleome multicaulis*) is present in the Chain Lakes area as needed for Bureau of Land Management (BLM) review and planning purposes. Many-stemmed spider-flower is a BLM sensitive species that occupies meadows associated with alkaline lake habitats, mapped as playa vegetation. It has been surveyed to the north in the Casper Field Office where it is only known from one area (Fertig et al. 1994, Fertig 1993, 2000a, b); but it has not been surveyed in the Rawlins Field Office. It is otherwise only known from extant populations in south-central Colorado, in addition to parts of Arizona, New Mexico, Texas and Mexico where it has not been found in recent decades.

The general botanical literature on Wyoming alkaline lake wetland species and playa vegetation is scarce. Specifically, there were no known sensitive plant species in the Chain Lakes area or other Wyoming plant species of concern with the two species that are no longer tracked (Nevada bulrush records, *Amphiscirpus nevadensis*; and little bun millkvetch, *Astragalus simplicifolius*). This study addresses the sensitive species resources and vascular flora of the Chain Lakes area that lie mainly within three U.S.G.S. 7.5' topographic maps (Hansen Lake, Hansen Lake Northeast, and Larsen Knoll). The Chain Lakes area and other alkaline lakes in the Great Divide Basin are part of the largest area of playa vegetation in Wyoming.

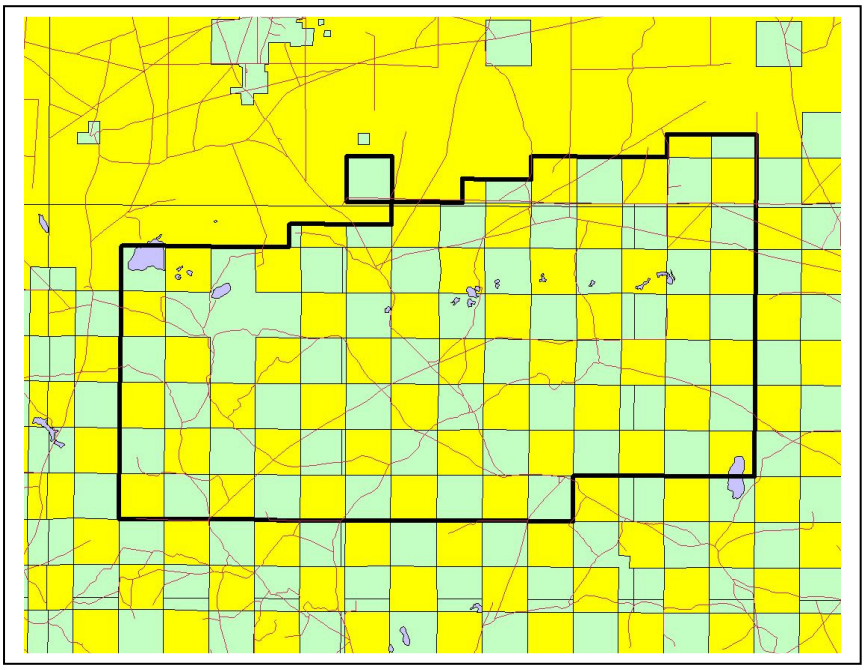

Figure 1. Chain Lakes study area, a checkerboard of BLM (yellow) and state (green) lands

STUDY AREA

Chain Lakes Wildlife Habitat Management Area is an area of 60,946 acres (24,664 ha, about 95 mi²; excluding open water) in the Great Divide Basin of eastern Sweetwater County, Wyoming (Figure 1). The Chain Lakes Wildlife Habitat Management Area provides winter habitat for pronghorn antelope and protects migration routes between summer and winter ranges (Wyoming Game and Fish Department 2007). All reference to the Chain Lakes study area in this report refers to the designated wildlife habitat management area unless otherwise stated. Chain Lakes Wildlife Habitat Management Area is managed in cooperation between Wyoming Game and Fish Department and the Bureau of Land Management – Rawlins Field Office. The low-lying bottomland of Chain Lakes spans an area about 4 mi² (about 0.75 mi x 5.2 mi), and contains over 200 wetlands as mapped on U.S.G.S. topographic maps (7.5') , with few inlets and no outlets except for a few seasonal streams between wetlands. Elevation ranges from 6498-6952 ft (1981-2119 m).

The Great Divide Basin is a closed basin along the Continental Divide between the Sierra Madre and Wind River Range. There are no drainages that leave the basin, and only seasonal creeks drain toward its interior. It is part of the Red Desert, an open area of south-central Wyoming with extensive intermontane steppe. The Chain Lakes part of the Red Desert averages 6 ½ in (16.5 cm) of precipitation.

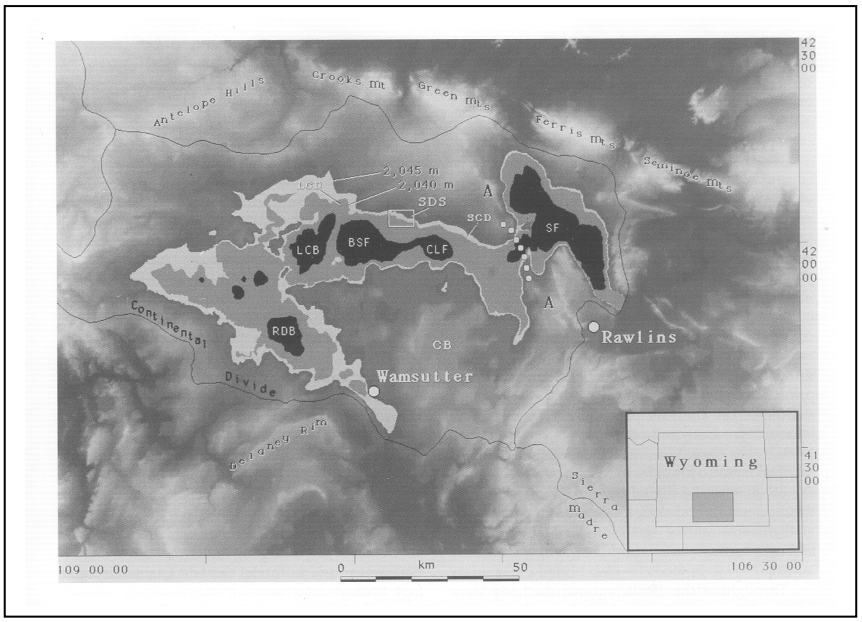

Figure 2. Quaternary Lake Wamsutter, from Marrs and Grasso (1993). Note the central black area marked "CLF" = Chain Lake Flats.

South-central Wyoming, within which the Great Divide Basin lies, had as many as 100 perennial lakes in topographic closed basins during the late Pleistocene (Benson and Thompson 1987). The largest of these was Lake Wamsutter (Figure 2), a Quaternary paleolake basin that engulfed earlier lakes and may have once occupied 2000 km² across much of the Great Divide

Basin (Grasso 1990). Clay-rich lacustrine deposits accumulated in the deepest parts of the Lake Wamsutter. Vestigial lake features include remnant shorelines, deltas, and lake-margin sand dunes that marked a succession of lake levels. The maximum predicted level of the lake closely parallels the maximum extent of clay-rich lacustrine sediments in the basin (Marrs and Grasso 1993). Stratigraphic investigations lead to the hypothesis that Lake Wamsutter overtopped its eastern divide and drained rapidly into the North Platte River to the east (Marrs and Grasso 1993). After it emptied, Holocene-age fluvial, colluvial, and eolian sediments buried large portions of the former lakebed (Marrs and Grasso 1993).

Chain Lakes Flat and the confluent Battle Spring Flat are centrally-located at the deepest parts of former Lake Wamsutter. The extent of clay-rich lacustrine deposits that underlie Chain Lakes correspond with playa vegetation today. The playa landscape lies in the east-west trending Chain Lakes valley in the north half of the study area (Figure 1). Despite the flat, uniform lakebed origin of the Chain Lakes landscape, deposition and erosion patterns of Holocene sediments have formed elaborate microtopography, made even more complex by the movement of water and migration of minerals in this system. They are briefly described in the following paragraphs, and vegetation descriptions follow.

The topography is re-worked by the wind across much of the low-lying central playa basin. Extensive, transverse dunes of silt look like a sea of rolling waves less than 1 m high. Choppy dunes of silt sediment are located directly downwind from alkaline lakes, formed from reworked lakebed sediments, rising 3-7 m high.

The many lakes and wetlands of the Chain Lakes study area represent natural drainage depressions without outlets, and vary by size, slight differences of depth, patterns of groundwater movement into and in some cases out of the basin, and presumably, by electrical conductivity. Almost all are mapped on U.S.G.S. topographic maps (7.5') as intermittent lake/pond basins. Only three are mapped as perennial lake/pond, and there is one mapped as dry lake/pond. All of the largest basins are mapped, but large, alkaline wet meadow flats are not mapped.

Based on 2007 observations, it appears that the Chain Lakes wetlands span a range of conditions from temporary to semi-permanent conditions. There are no deepwater (lacustrine) systems in this landscape in the strict sense. In general, they exhibited very little zonation (successive bands of hydrological as conditions exhibited by vegetation changes radiating outward from the open water zone). There are fundamental questions about the natural hydrological regime that cannot be answered by one-time visits during a drought cycle, or without review of secondary information resources. It was observed that at least one of the three areas mapped as perennial lake/pond in 1960 (with 1981 updates) had areas of exposed lakebed at the time of visit, and might be expected to have evaporated by the end of the 2007 growing season. It was observed that Circle Bar Lake, mapped as a dry lake/pond, did not show signs of having held any water in 2007. It was observed that the area identified as "Chain Lakes" on the Larsen Knoll Quadrangle, mapped as intermittent lake/pond in 1960 (with 1981 updates), did not show signs of having held any water in 2007 either.

Not all of the wetland vegetation is in discrete basins. There are extensive wet meadow flats associated with subirrigated conditions in low-lying basin positions near current or former

basin margins, segments of wetland borders, and occasionally in basins. There are also well-developed wet meadow communities perched on pedastals less than 0.5 m tall, located at central areas of the playa landscape. Calcium carbonates accumulate in wet meadows, an accumulation and deposition that is particularly pronounced on the perched pedastals, that appeared like stools caked in bicarbonates. The upward migration and successive deposition of calcium carbonates might contribute to the pedestal formation in which wet meadow microhabitat is elevated above and surrounded by barren, much drier and more alkaline flats.

In addition to wet meadows, there are sometimes springs in the wet meadow habitat, and occasionally a quaking mat forming over the spring. Artesian water flows contribute greatly to the hydrological complexity of the landscape. In addition, widely-scattered conical mounds rise above the rolling topography, and appear to correspond with features described as "mud springs" or "mud volcanos" by the Hayden Expedition (Dorn 1986, Knight 1994) that looked like beehives 2-15 ft high. They were determined to have held gas under pressure. These conical mounds no longer hold pools of open bubbling water at the top, but apparently "healed over." There were observed to be mud pots, or "bentonite boils" of suspended silt perched on low terraces near Circle Bar Lake still present.

There was limited information to assess which of these zones was more apt to support many-stemmed spider-flower. Therefore, brief vegetation descriptions supported by plant collections were developed for the aforementioned features. The core low-lying area is playa vegetation of greasewood fans and flats, all surrounded by sagebrush grasslands, as mapped in the original Wyoming Gap Analysis map (Merrill et al. 1996, Driese et al. 1997). The homogeneity of this mapping contrasted sharply with the heterogeneity and small-scale patchwork of vegetation on the ground. The description of playa vegetation that follows is a preliminary qualitative characterization.

Dunes of silt are dominated by greasewood (*Sarcobatus vermiculatus*), with variable cover of Cusick's bluegrass (*Poa cusickii* var. *pallida*). The choppy dunes are more sparsely-vegetated than the rolling dunes, and vegetation on them more prone to being buried or eroded out. Soil structure differences were also noted. The low-lying spaces between dunes are unvegetated or sparingly vegetated.

Wetland vegetation is diverse in the study area. Open water wetlands appear to have brackish, turbid conditions without submerged vascular plants. Wetland shorelines usually have a continuous or semi-continuous emergent border, though most of the borders are very narrow. In 2007, low-water levels exposed many areas where wave-beaten shorelines were held together by root masses that rose like an eroded-out shelf at the waters' edge. Common species along the shoreline included three-square (*Schoenoplectus pungens*), Baltic rush (*Juncus balticus*), common spikerush (*Eleocharis palustris*), Rocky Mountain goosefoot (*Chenopodium glaucum* var. *salinum),* meadow barley (*Hordeum brachyantherum*), spreading alkaligrass (*Puccinellia distans*), western wheatgrass (*Elymus smithii*), wild licorice (*Glycyrrhiza lepidota*), occasionally Canada thistle (*Cirsium arvense*); and less commonly hard-stem bulrush (*Schoenoplectus acutus*).

The composition of wet meadows, whether on flats or pedastals, is similar. Wet meadows have some of the highest local species diversity. Most were dominated by combinations of Baltic rush (conspicuously dark on aerial photographs if dominant), tufted hairgrass (*Deschampsia cespitosa*), clustered field sedge (*Carex praegracilis*), alkali cordgrass (*Spartina gracilis*), few-flowered spikerush (*Eleocharis quinqueflora*), branched wild rye (*Elymus multicaulis*), slender wild rye (*E. trachycaulus*), and alkali sacaton (*Sporobolus airoides*). Showy associated species included dark-throat shooting-star (*Dodecatheon pulchellum*) and purple-flower lousewort (*Pedicularis crenulata*), in addition to pale false-dandelion (*Agoseris glauca* var. *glauca*), Colorado thistle (*Cirsium tioganum* var. *coloradense*), dry-spike sedge (Carex foena), Parry's sedge (*Carex parryana*), fiddle-leaf hawksbeard (*Crepis runcinata* var. *runcinata*), sweetgrass (*Hierochloe odorata*), and lance-leaf goldenweed (*Pyrrocoma lanceolata*).

Salt flats have sparse cover and composed of plants like alkali saltgrass (*Distichilis stricta*), spreading alkaligrass (*Puccinellia distans*), and red-wooly plantain (*Plantago eriopoda*); mixed in with unvegetated expanses.

The "mud mounds" or "mud volcanos" have vegetation similar to greasewood dunes, but a wider range of environmental conditions and with it, a greater diversity. Mud mounds have variable soil textures that include sand, more zonation associated with aspect, and more surface contour variations that sometimes have differences in composition. In addition to greasewood, there are shrubs like green rabbitbrush (*Chrysothamnus viscidiflorus* var. *viscidiflorus*) and shadscale (*Atriplex confertifolia*); and subshrubs like fringed sagebrush (Artemisia frigid) and Wyoming pepperwort (*Lepidium montanum* var. *wyomingense*; treated as a synonym of *L. m.* var. *montanum* by some authors), sometimes with an array of annuals (including rare species).

There was only one place found with a floating mat overlying a spring, dominated by analogue sedge (*Carex simulata*) and few-flowered spikerush (*Eleocharis quinqueflora*).

Above the playa vegetation are localized areas dominated by Gardner's saltbush (*Atriplex gardneri*; possibly both varieties) w/o bottlebrush squirreltail (*Elymus elymoides*). Bird-foot sagebrush (*Artemisia pedatifida*) is a widespread dominant, variously with alkali saltgrass or species of wheatgrass (*Elymus* spp.). The least salt-affected vegetation in the area was dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyominengis*) and thickspike wheatgrass (*Elymus lanceolata*) appears to be the most common grass.

Included in the Chain Lakes Wildlife Habitat Management Area boundaries, but hydrologically separate, is Mud Lake. It straddles the study area boundary in the southeast corner. It was visited in 2007, and was found to have shorelines that were sandy flats, and greasewood communities that did not have the habitat development of playa vegetation in the Chain Lakes area. Another alkaline lake series further east in the Great Divide Basin was visited in 2006 to look for many-stemmed spider-flower, at Boggy Lake and an unnamed lake to the west. Boggy Lake has choppy silt dunes downwind from the lake, similar to Chain Lakes, and both of the two lakes had areas of greasewood flats at the margins, but the playa vegetation appeared to be limited to proximity of the alkaline lakes rather than being continuous.

METHODS

Before the field season, digital orthophotographs for the study area were assembled and printed out as quarter-quad pages that matched the scale of U.S. Geological Survey topographic maps (7.5' Quad). The digital orthophotographs were used to target areas of potential alkaline meadow habitat as well as for identifying and navigating around wetlands. A complementary set of BLM surface management maps (1:100,000) and U.S.G.S. topographic quads (7.5') were also assembled.

Initial study area boundaries were set at the Chain Lakes Wildlife Habitat Management Area boundaries, with provision for extensions as dictated by sensitive species results. Surveys were conducted June 19-20 and June 30-July 1 in five areas that spanned the breadth of the study area (Appendix A; plus the 2006 survey at Boggy Lake). Land ownership information wasn't confirmed at the time of the first visit when the checkerboard of lands mixed in with federal lands was interpreted to be private lands as mapped on the BLM surface management map that covered most of the area (Rawlins 1:100,000 of 1991), and thus off limits for study.

A two-pronged approach was taken in field surveys to cover habitats that might be suitable for many-stemmed spider-flower, and to investigate the flora for any other Wyoming plant species of special concern as found in the playa landscape. Surveys were conducted from five main access routes at far ends of the study area and intermediate stations (Appendix A). Upland vegetation surrounding the playa landscape was not surveyed, except incidental to local travel with spot-checks. The spectrum of alkaline wet meadows and adjoining greasewood habitats were targeted in many-stemmed spider-flower survey, in keeping with past status surveys and characterizations of species' habitat requirements (Fertig 1993, 2000a, b; Fertig et al. 1994). Reference points were taken using a Garmin eMap unit for recording Geographical Position System data within alkaline meadow vegetation. These reference points were for use in later photointerpretation.

All Wyoming plant species of concern were documented on sensitive species of concern forms, GPS points were taken with a Garmin eMap unit, photographs were taken of the species and their habitats, and voucher specimens were collected. In light of the study area habitat diversity and conditions that were found, a preliminary floristic list with voucher documentation was also pursued. There were also GPS values recorded in areas of homogeneous vegetation as photointerpretation reference before knowing whether or not they supported rare species, as an aid in photointerpretation.

RESULTS

Many-stemmed spider-flower (*Cleome multicaulis*) was not found in the Chain Lakes botanical survey, but there was a spider-flower noted in bud at the very end of surveys. It appeared to be associated with a very small area of disturbance southeast of Hansen Lake where patterns suggested there had once been a homestead. They were inferred to represent common spider-flower (*Cleome serrulata*).

Four other Wyoming plant species of concern were documented (Table 1; Figure 3; Appendix B). While none of the four species are recognized as sensitive by the Wyoming Bureau of Land Management, two are regional endemics of note. Meadow milkvetch (*Astragalus diversifolius*), had not been seen in Wyoming since it was first collected in 1834 by Thomas Nuttall, early botanical explorer (Heidel 2007). Pale blue-eyed grass (*Sisyrinchium pallidum*) had not previously been found outside of Albany and Carbon counties in Wyoming, marking a western range extension.

Table 1. Wyoming plant species of concern at Chain Lakes

Scientific Name	Common Name	Grank	Srank	Significance
Astragalus diversifolius	Meadow milkvetch	G2	Changed from SH to S1	Rediscovery of species known only from historical collection in state
Monolepis pusilla	Red poverty-weed	G5	Changed from S1 to S2	First record in Rawlins FO
Phacelia tetramera	Tiny phacelia	G4	S1	Third record in state; first record in Rawlins FO
Sisyrinchium pallidum	Pale blue-eyed grass	G2G3	S2S3	Range extension – westernmost

The distribution of current (and former) Wyoming plant species of concern is represented in Figure 3. The southern point represent in Figure 2 represents a collection record of *Astragalus simplicifolius* (an upland species that is no longer tracked). Two points in the upper left of Figure 3 are outside the study area: *Amphiscirpus nevadensis* (no longer tracked) is represented by the westernmost point along Circle Bar Lake. *Astragalus diversifolius* is represented by the point that lies distinctly north of the study area; one of the two populations that was documented in this study. The other population of *Astragalus diversifolius* is represented by the easternmost set of points inside the study area.

See Appendix A for the extent of surveys (over half of the length of Chain Lakes), Appendix B for details of the occurrence records for all four current Wyoming plant species of concern, and Appendix C for the current state plant species abstracts for the four species that reflect 2007 survey results.

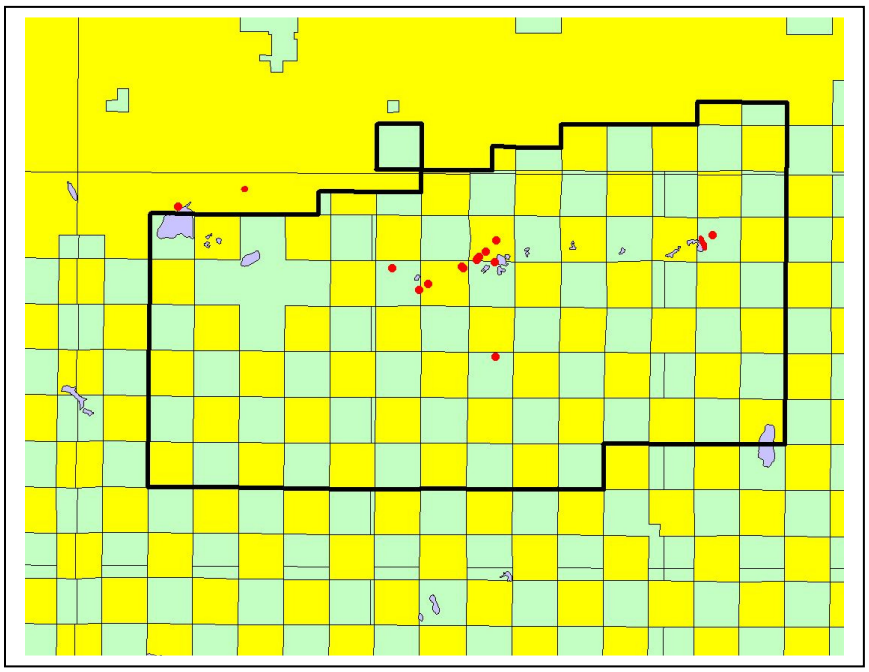

Figure 3. Current (and former) Wyoming plant species of concern in the Chain Lakes area (red dots)

The rest of this section highlights the Chain Lakes plant species results as they contribute to an understanding of species' status in Wyoming. They are synthesized in the discussion section. A total of 88 vascular plant species have been determined to date in the Chain Lakes study area (Appendix D), based on collections and notes taken mainly in surveying playa habitat. There are a total of 11 vouchered or observed species that represent additions to the Sweetwater County flora. All collecting was done within the two-week span of field surveys, and was focused on central low-lying wetland vegetation, so the list is partial and preliminary at best. All photographs in this report were taken during in the study area.

Meadow milkvetch (*Astragalus diversifolius*)

Meadow milkvetch (*Astragalus diversifolius*) is the rarest Wyoming plant species of concern discovered in the study area. It was previously collected by Thomas Nuttall in 1834 in the "Colorado of the West", generally referring to the Green River Basin (Heidel 2007). This species is ranked globally imperiled (G2), known from isolated locations that may reflect its restriction to playas, as found in east-central Idaho, the southwestern edge of the Salt Lake Desert in western Juab and Tooele counties, Utah, and in the Spring Valley area of southern White Pine County, Nevada. It was previously ranked as known only from historic records in Wyoming (SH), and its rediscovery is basis for re-assigning it the state rank of "S1". It is also ranked as a sensitive species by the BLM in Idaho.

The features that parallel or distinguish *Astragalus diversifolius* from lesser rushy milkvetch (*Astragalus convallarius*; syn.= *A. diversifolius* ssp. *campestris* var *campestris*) are highlighted as follows. The flowers of both species are whitish to cream or pale pink (Figure 4). *Astragalus convallarius* has narrower fruits (2-2.5 mm broad) over 20 mm long (i.e., over 8x as long as wide), very narrowly linear leaflets, and grows upright or ascending. It generally grows in dry habitats.

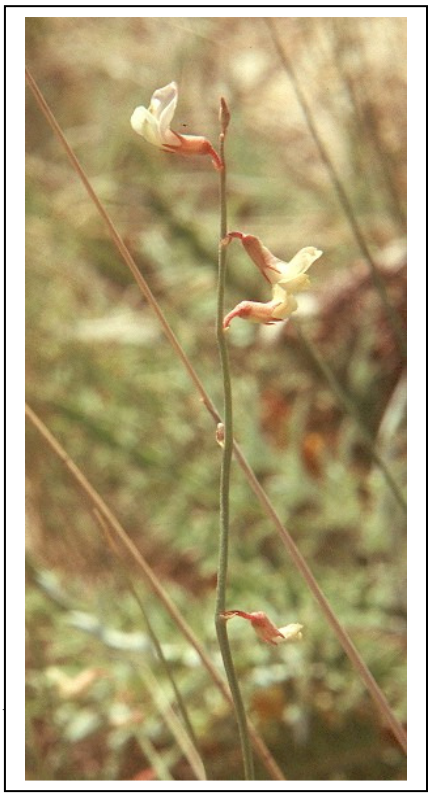

Figure 4 (left): *Astragalus diversifolius* flower close-up

Figure 5 (above): Single branch of *Astragalus diversifolius*
Photos by B. Heidel

Meadow milkvetch grew in sprawling or prostrate forms (Figure 5), usually with 5-20+ branches, sometimes at high densities where it was not possible to made distinction between individuals. The photo in Figure 4 was taken of a prostrate branch that was lifted and folded over for photographing the sprawling growth form. As mentioned above, it is more conspicuous in flower, but fruits are needed for unequivocal determination and only some of the material collected in 2007 included fruits. It is possible that phenology was about 2 weeks advanced for this species in 2007 as it was for many other species locally. If this is the case, then the timing of surveys in most years would begin in mid-July.

In Chain Lakes, meadow milkvetch is at 6500 ft (1981 m), representing the upper elevation limits throughout its range. It has been found in two locations at opposite ends of the study area (about 15 miles apart), in settings that are at the outer edges of playa vegetation. One of these settings stands out in aerial photos as a well-vegetated seep zone that appears to mark the discharge zone at a former shoreline of a lake that apparently no longer holds water. The abundance of Baltic rush (*Juncus balticus*) makes this zone show up as a dark band. The other setting is where a dry wash reaches the perimeter of playa vegetation at a seasonally-wet flat, and there is a distinct dominance of alkali sacaton (*Sporobolus airoides*). There were not other areas seen where this grass formed high-cover communities on flats.

The meadow milkvetch at this site it is associated with branched wild rye (*Elymus multicaulis*), clustered field sedge (*Carex praegracilis*), Nevada bluegrass (*Poa nevadensis*), lance-leaf goldenweed (*Pyrrocoma lanceolata*), alkali cordgrass (*Spartina gracilis*), and Colorado thistle (*Cirsium tioganum* var. *coloradense*). At the other site, meadow milkvetch occurs in a distinct pocket of alkali sacaton and clustered field sedge where an ephemeral wash

reaches the outer margins of the playa vegetation. Other species present at the alkali sacaton site included pale false-dandelion (*Agoseris glauca* var. *glauca*), red-wooly plantain (*Plantago eriopoda*), and arrowhead thelypody (*Thelypodium sagittatum*). There were no populations found of lesser rushy milkvetch (*Astragalus convallarius*) in the study area, the species that it most closely resembles, though upland habitats were not surveyed except in accessing playa vegetation. Figures 6-8 (below) show the site of the most extensive *Astragalus diversifolius* habitat as found at the eastern end of Chain Lakes; Figure 9 shows habitat at the western end.

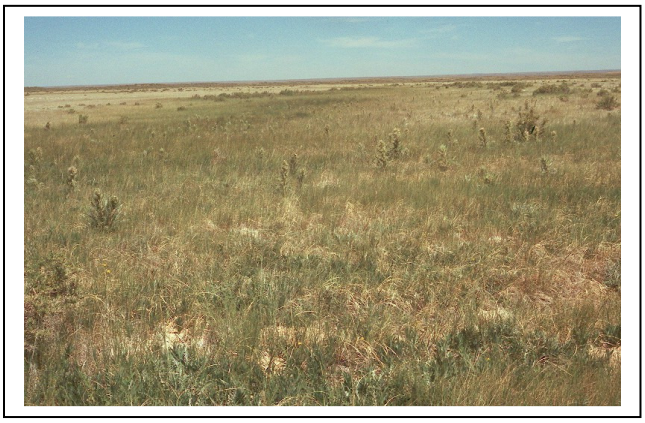

Figure 6 (above). *Astragalus diversifolius* habitat. By B. Heidel

Figure 7 (above). *Astragalus diversifolius* habitat, as viewed from the nearest ridge (dark band at central right). By B. Heidel

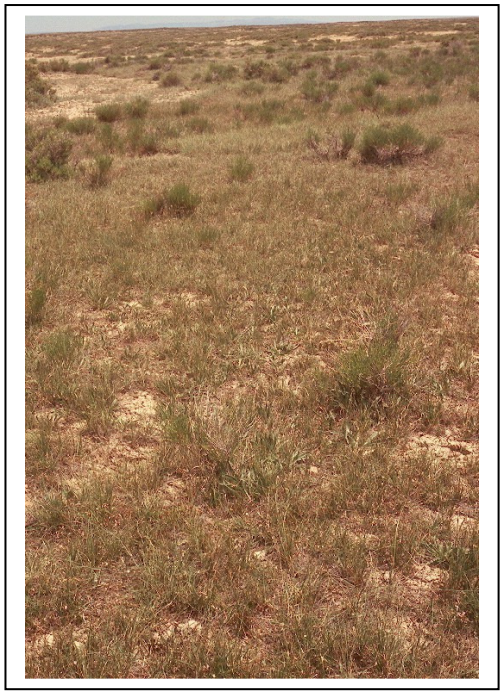

Figure 8 (left): *Astragalus diversifolius* habitat as appearing like black bands above a lake shoreline in upper right of aerial (corresponds with Figures 5-6)

Figure 9 (above): *Astragalus diversifolius* habitat on well-vegetated flats near west end of Chain Lakes (foreground). By B. Heidel.

There was only one soil sample collected over the course of 2007 surveys, taken to represent meadow milkvetch habitat where first documented (Circle Bar Lake vicinity). That silty clay loam soil sample had high electrical conductivity (EC) and high sodium absorption ratio (SAR). An analysis on the one sample at the University of Wyoming Soils Testing Laboratory determined surface horizon characteristics (Table 2). In addition, strong evanescent reactions to hydrogen chloride were noted at this site and at wet meadow substrates elsewhere, reflecting the major calcium bicarbonate component.

Table 2. Soil characteristics at one *Astragalus diversifolius* site (corresponds with Figure 9)

Property	Soluble Calcium MEQ/L	Soluble Magnesium MEQ/L	Soluble Sodium MEQ/L	SAR	pH	EC DS/M
	28.1	84.9	169.5	22.6	8.15	18.5

Elsewhere in its range, meadow milkvetch has been characterized as a species of alkaline meadows with moist soils and flat or hummocky topography, supporting graminoid or medium height shrub vegetation (Idaho Data Conservation Center 2007). The associated species may include Baltic rush (*Juncus balticus*), curly bluegrass (*Poa secunda*; note: *P. nevadensis* is included with this taxon by some authors), *Great Basin wild rye (*Leymus cinereus*), alkali cordgrass (*Spartina gracilis*), *weak-stem groundsel (*Senecio debilis*), *Kelsey's phlox (*Phlox kelseyi*), *sea milkwort (*Glaux maritima*), greasewood (*Sarcobatus vermiculatus*) and *shrubby cinquefoil (*Potentilla fruticosa*). Species that have not been noted in the Chain Lakes playa vegetation to date are indicated by an asterisk before the common name.

Red poverty-weed (*Monolepis pusilla*) and tiny phacelia (*Phacelia tetramera*)

The two annual species, red poverty-weed (*Monolepis pusilla*) (Figure 10) and tiny phacelia (*Phacelia tetramera*) (Figure 11) are part of a guild of annuals that have not been reported as such in Wyoming. Both are Great Basin species at the northern edges of their ranges in southwestern Wyoming.

Figure 10 (left): *Monolepis pusilla*. By B. Heidel
Figure 11 (above): *Phacelia tetramera*. By B. Heidel

In Chain Lakes, the red poverty-weed and tiny phacelia were basically restricted to mud mounds, but are not present consistently on every mound. The mounds often have a veneer of sand. These widely-scattered mounds might number anywhere from about two to ten mounds per section, and were traversed in accessing the primary alkaline meadow habitat targets. A close-up of mound habitat is shown on the front cover. Associated annual species included cushion cat's-eye (*Cryptantha circumscissa*) and Green River suncup (*Camissonia minor*), as well as the perennials like greasewood (*Sarcobatus vermiculatus*), Utah Gardner's saltbush (*Atriplex gardneri* var. *utahensis*), and Wyoming pepperwort (*Lepidium montanum* var. *wyomingensis*). The mounds were not consistently distinguishable on aerial photography. An example of mound vegetation is shown in the foreground of the report cover.

Most mounds were small areas of much less than 10 m x 10 m, and the occupied microhabitat within them was much smaller. Colony size of *Phacelia tetramera* plants numbered from about 10-100 individuals per locale, and colony size of *Monolepis pusilla* reached up to twice the number in some places.

There is another small annual phacelia present in the study area, Ive's scorpionweed (*Phacelia ivesiana*) that is sometimes found on the mud mounds as well as above the playa vegetation on south-facing slopes. However, *Phacelia ivesiana* has pinnately-lobed rather than entire leaves like *P. tetramera*. The annuals had curtailed growth and were forming their last flowers and fruits at the start of survey (June 19, 2007). It is not known how early they might shift in phenology in those years with early growing seasons such as 2007. Some annuals like tiny phacelia may be episodic in appearing from year-to-year, as determined by climate conditions. Surveys timed to focus on these species would probably be better conducted in early rather than late June.

Pale blue-eyed grass (*Sisyrinchium pallidum*)

Pale blue-eyed grass (*Sisyrinchium pallidum*) is a regional endemic of intermontane basins in the Laramie, North Platte and Great Divide basins of south-central Wyoming and North Park, Colorado. It has also been collected at the east end of the Great Divide Basin (*Fertig 19141, 19263 RM*). Its presence in Chain Lakes represents a new county record and a small western range extension. It was originally designated a BLM sensitive species on the first sensitive plant list (USDI BLM 2001). It is not clear if it was removed from this list based on available status information, or question at the time whether or not it occurred on BLM-administered lands.

Pale blue-eyed grass is distinguished from other members of the genus by technical bract characteristics: an outer bract nearly twice or more the length of the inner, and the inner bract with a hyaline margin along the full length to the tip. It is noticeably pale blue compared to other species (Figure 12).

Figure 12. *Sisyrinchium pallidum*. By B. Heidel

In Chain Lakes, pale blue-eyed grass was restricted to well-developed wet meadow habitat with high vegetation cover and litter accumulation compared to the sparse vegetation conditions that prevail. There might have been over 100 wet meadow pedastals and wet meadow flats that were surveyed (see Appendix E for a photo of pedestal habitat), but it was only found on a few, and only found to be common in one meadow flat. Associated species included tufted hairgrass (*Deschampsia cespitosa*), Baltic rush (*Juncus balticus*), dark-throat shooting-star (*Dodecatheon pulchellum*), purple-flowered lousewort (*Pedicularis crenulata*), and lance-leaf goldenweed (*Pyrrocoma lanceolata*).

Pale blue-eyed grass survey in 2007 was not started until the very end of the month when it appeared to be at peak flowering. It is not known how much of a shift there might have been in the 2007 growing season compared to more typical years.

A species conservation assessment was prepared for pale blue-eyed grass (Moore and Friedley 2004) that updated known distribution information, indicating that there are 39 extant occurrences known from South Park, Colorado and 27 from Albany and Carbon counties, Wyoming (since updated to 29). It is difficult to present a unified status picture because the two discrete distribution centers in the two states have fundamentally different habitat conditions. However, in both areas, the majority of occurrences occur on private land, subject to hydrological alteration and development. Based on this current information, the global rank is being changed from G2G3 (assigned when there were scarcely more than 20 extant occurrences) to G3. It is vulnerable but not considered imperiled at this time.

In addition to the plant results that were documented, a pair of western snowy plovers (*Charadrius alexandrinus nivosus*) was observed from all angles through binoculars. The pair showed nesting behavior on top of a bare silt rim built up between two alkali lakes. The nesting site was located in T23N R92W Sec. 17 NE ¼ of NE ¼ of NW ¼, Western snowy plovers are not known to breed in Wyoming, and this observation has been reported for ornithological confirmation.

DISCUSSION

The apparent fidelity of Wyoming plant species to specific segments of playa vegetation at Chain Lakes may indicate that this vegetation and flora are not well-documented. Vegetation descriptions are rudimentary and survey results for species of concern are partial, but they provide a basis for further evaluating botanical resources within and between playa vegetation areas.

More specifically, the information provided in this study provides a framework for systematically surveying the botanical resources of playa vegetation across the Great Divide Basin, broadening the geographic scope, and ensuring phenological completeness. It is appropriate to expand survey of meadow milkvetch and other Wyoming plant species of concern using digital color infrared photographs to identify site priorities on public land. From the information at hand, seeps and water collection flats at the perimeter of the Basin should be surveyed for meadow milkvetch. The largest wet meadow flats might also be surveyed for pale blue-eyed grass. The preliminary flora of Chain Lakes might be expanded to cross-reference the discrete playa vegetation types and separate basins in the Great Divide Basin landscape (Spring Flat, Lost Creek basin, and others), also expanding the phenology of visits.

At present, while digital aerial photographs appear to be well-suited for identifying potential habitat for meadow milkvetch, a more complete consideration of existing information resources is warranted. Other information resources are to be sought and evaluated if there are detailed soil surveys, or detailed National Wetlands Inventory mapping of alkaline wet meadow flats that might serve to identify potential habitat.

The environmental conditions of the Chain Lakes area and its Wyoming species of concern could be much better understood if soils were mapped or at least a soils classification made in each major vegetation type.

No apparent threats or management concerns were identified in association with the study area species of concern. Invasive species such as halogeton (*Halogeton glomeratus*) and cheatgrass (*Bromus tectorum*) were not noted in the playa vegetation, though the latter is present in surrounding uplands. Canada thistle (*Cirsium arvense*) is only on shorelines of the largest lakes at limited levels, and uncommon or absent in the rest of wet meadow habitats. Summer cypress (*Bassia sieversiana*) was the only widespread non-native species noted in playa vegetation. The playa habitat conditions may preclude invasion of most other non-natives. The low water levels noted (see study area description) are quite possibly linked to 8-year drought conditions.

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