Attachment 1

Ute ladies'-tresses orchid Biology, Life History, and Ecology

UTE LADIES'-TRESSES ORCHID BIOLOGY, LIFE HISTORY, AND ECOLOGY
June 1, 1995

Introduction

The Ute ladies'-tresses orchid (Spiranthes diluvialis) was listed as a threatened species on January 17, 1992 (England 1992) under the authority of the Endangered Species Act of 1973 (Act), as amended. The U.S. Fish and Wildlife Service (Service) is responsible for preparing a recovery plan and guiding actions that will restore populations and remove threats such that the species no longer requires protection under the Act and can be removed from the list of threatened species.

Description

Spiranthes diluvialis is a perennial, terrestrial orchid with stems 2 to 5 dm tall, arising from tuberously thickened roots. Its narrow (1.0 cm) leaves can reach 2.8 dm long. Basal leaves are longest and become reduced in size up the stem. The flowers consist of few to many small white or ivory flowers clustered into a spike arrangement at the top of the stem. The species is characterized by whitish, stout, ringent (gaping at the mouth) flowers. The sepals and petals, except for the lip are rather straight, although the lateral sepals are variably oriented, these often spreading abruptly from the base of the flower; sepals are free to the base. The rachis is pubescent with the longest trichomes 0.2 mm long or longer, usually much longer. It blooms, generally, from late July through August. However, depending on location and climatic conditions, orchids may bloom in early July or may still be in flower as late as early October.

Taxonomy

Prior to the description of Spiranthes diluvialis in 1984, workers in Orchidaceae had tried to accommodate specimens from the West in three taxa of white-flowered Spiranthes orchids: Spiranthes cernua L.C. Richard, Spiranthes romanzoffiana Chamisso, and Spiranthes porrifolia Lindley.

Nineteenth and early twentieth century problematic collections from Nebraska, Colorado, Utah, and New Mexico were reported in the literature as one or more of the above taxa and some herbarium specimens had multiple annotations as different taxa. Prior to studies on the genus Spiranthes initiated by Charles J. Sheviak in the early 1970's, the major works on the genus were contributed by Ames (1905), Correll (1950), and Luer (1975), whose opinions on the genus differed substantially. The delimitation of species in Spiranthes is often difficult due to the lack of distinctive morphological characters that preserve well in the herbarium and the postulated occurrence of hybridization.

In 1980, a specimen of Spiranthes was collected near Golden, Colorado, that appeared to be Spiranthes cernua. In 1981, live plants were collected at that site and sent to Dr. Sheviak for examination. In 1982 and 1983, Dr. Sheviak visited Colorado and Utah. After examining herbarium specimens and live

specimens in the field and after cytologic study, Dr. Sheviak was convinced that the Colorado-Utah plants were a new species, which he described in 1984 (Sheviak 1984). The type locality is along Clear Creek west of Golden.

The correct treatment for problematic collections is as follows:

A specimen collected along the North Platte River on September 22, 1859, by Henry Engelmann and previously identified as Spiranthes cernua, is S. magnicamporum. A specimen also collected by Henry Engelmann on an unspecified day in September, 1856, along South Platte River was actually taken in Weld or Morgan Counties, Colorado, and is S. diluvialis. Attributed to Nebraska, it, too, was previously identified as Spiranthes cernua.

Collections from the Rio Grande Valley and Española (Rio Arriba County), New Mexico, attributed to S. cernua by Ames (1905), Correll (1950), and Holmgren in Cronquist (1977) are S. magnicamporum as shown by Luer (1975). The "Camp Harding, near Pikes Peak" collection cited by Rydberg (1906) as S. porrifolia, is in fact Spiranthes diluvialis, collected in what is now suburban Colorado Springs.

All specimens of S. porrifolia cited for Nevada have been taken at the eastern foot of the Sierra Nevada, generally near Carson City. It is not at all unusual to find S. porrifolia in this area, which is adjacent to the California state line.

Low-elevation Utah collections, assigned by various workers to S. romanzoffiana (Ames 1905), S. porrifolia (Correll 1950, Holmgren in Cronquist 1977, Luer 1975 and Welsh 1987), S. cernua (Correll 1950, Holmgren in Cronquist 1977, and Welsh 1987), and S. magnicamporum (Luer 1975), are S. diluvialis.

In his original description, Sheviak (1984) suggested that Spiranthes diluvialis resulted from the hybridization of Spiranthes magnicamporum and Spiranthes romanzoffiana during a Pleistocene pluvial period when the region supported lush grasslands and the two parent species would have been sympatric or parapatric. Under a cooler and wetter climate, Spiranthes romanzoffiana would have occurred at lower elevations. As the climate became drier, the boreal S. romanzoffiana retreated to higher elevations and S. magnicamporum retreated to the eastern Great Plains. S. diluvialis persisted in warm wet situations, eventually becoming more limited to scattered areas of permanent moisture.

Sheviak has published extensively on the taxonomy of genus Spiranthes (Sheviak 1973, 1982, 1984, 1989, 1990, Sheviak and Catling 1980) and has regularly reported cytological data on the genus. The number of chromosomes for species of white-flowered Spiranthes in the United States is based on 15, 22, and 37. Spiranthes magnicamporum, S. ochroleuca, S. odorata, S. lacera, and S. vernalis are all diploids with 2n=30. Spiranthes cernua is a polyploid complex presenting numerous forms with 2n=45, 60, or 61 and polyembryonic seeds. Spiranthes lucida, S. romanzoffiana, S. porrifolia, and S. infernalis show 2n=44. Spiranthes delitescens from Arizona shows 2n=74.

Sheviak (1984) reported that counts from three populations of Spiranthes diluvialis in Colorado and Utah were uniformly 2n=74. Significantly, meiosis was regular, with the common formation of 37 bivalents. Sheviak concluded that the combination of morphological and cytological data suggests that the plant is an amphiploid derived from hybridization of S. magnicamporum (2n=30) and S. romanzoffiana (2n=44).

The hybridization process described above is technically known as allopolyploidy, and is an important mechanism of speciation in flowering plants. Grant (1971) estimated 47% to 52% of angiosperm species are the result of hybrid/polyploid origin, although this does not take into account speciation at the polyploid level. The duplication of chromosomes giving rise to a polyploid confers "instant" speciation on the new fertile polyploid due to complete reproductive isolation from the parental taxa. Generally, if the two parental species are sufficiently different, the resulting fertile tetraploid will form 2n sets of bivalents, as occurs in Spiranthes diluvialis, instead of n sets of irregularly segregating quadrivalents (Futuyma 1986).

A genetic survey employing protein electrophoresis has been conducted on nine populations of Spiranthes diluvialis as well as several populations of the putative parental species (Arft and Ranker, 1993). Protein electrophoresis separates isozymes (different forms of an enzyme) in an electric field, thus providing an indirect measure of the genetic makeup of individuals. Generally, isozymes are useful for detecting allopolyploid hybridization because the isozymes present in each of the putative parental species will be combined and detectable in the hybrid species. Results indicate the genetic makeup of Spiranthes diluvialis is a combination of those found in S. magnicamporum and S. romanzoffiana (Arft and Ranker, 1993).

Morphologically, S. diluvialis is intermediate between its putative progenitors. Spiranthes romanzoffiana is a montane plant of moist areas along streams and near lakes, rarely found below 2,438 meters (8,000 feet) in Colorado, and widely distributed across the northern part of the continent and in the western mountains to Arizona. Spiranthes romanzoffiana has a tight helix of inflated, ascending flowers around the spike, lateral appressed sepals, and a pandurate lip. Spiranthes magnicamporum is a plains plant of moist areas, which has nodding, tubular flowers, with free and ascending lateral sepals, and an ovate to lanceolate lip. The center of distribution of S. magnicamporum is in the Midwest, ranging from Texas to North Dakota. Disjunct stations in the Rio Grande Valley of New Mexico may indicate a once larger distribution for the species. Spiranthes diluvialis has flowers facing directly away from the stalk, neither ascending nor nodding, appressed or free lateral sepals, and a lip intermediate in shape between those of the putative parents.

Distribution

Populations of S. diluvialis occur in relatively low elevation riparian, spring, and lakeside wetland meadows in three general areas of the interior western United States: near the base of the eastern slope of the Rocky Mountains in southeastern Wyoming and north-central and central Colorado; in the upper Colorado River basin, particularly in the Uinta Basin; and along the

Wasatch Front and westward in the eastern Great Basin, in north-central and western Utah and extreme eastern Nevada. In 1994, the known range was expanded northward by discoveries in central Wyoming and western Montana. Figure 1 shows the distribution of the Ute ladies'-tresses orchid in the western United States excluding the Montana occurrence.

The eastern most large populations are located in mesic riparian meadows of relictual tall-grass prairie and irrigated pastures near South Boulder Creek at the southeast edge of Boulder, Boulder County, Colorado, and in mesic meadows in the riparian woodland understory along Clear Creek in adjacent Jefferson County.

The largest populations are managed by the City of Boulder Open Space Department and the city of Wheat Ridge. A few plants are known from the lower reaches of Clear Creek Canyon, west of Golden, significantly upstream from the larger populations near Golden and Wheat Ridge. Smaller populations are currently known from private land along St. Vrain Creek, near Hygiene, Boulder County (discovered 1992); on property owned by Colorado State University near the Cache La Poudre River at the northwest edge of Fort Collins, Weld County (discovered 1993); and on state-owned land along Bear Creek, Goshen County, Wyoming (discovered 1993). Historic collections were made in 1856 along the South Platte River, most likely near the mouth of Crow Creek; and in 1896 at Camp Harding in southwest suburban Colorado Springs, El Paso County (Jennings 1989, 1990).

Two populations discovered in 1994 expand the known range of the orchid considerably to the north. One population was found along Antelope Creek, a tributary to the Cheyenne River, in northwest Converse County, Wyoming (E. Nelson, Rocky Mountain Herbarium, in litt. 1994). One population was discovered in an old meander scar of the Jefferson River in Jefferson County Montana (B. Heidel, Montana Natural Heritage Program, in litt. 1994). Both of these discoveries are in the Missouri River drainage.

The central populations of the orchid are in wet or mesic riparian meadows or in understory wetland meadows of riparian woodlands in the Colorado River drainage of eastern Utah.

Several populations occur along the Green River below Flaming Gorge dam: two on BLM-administered federal lands and one on private land in Browns Park in Daggett County; one in Island Park; and one south of the Split Mountain Gorge, the latter two within Dinosaur National Monument. Additional populations occur within Dinosaur National Monument on small tributaries to the Green River: one in Hog Canyon, one in adjacent Cub Creek and one in Orchid Draw.

Spiranthes diluvialis populations occur on all the major drainages to the Green River along the south slope of the Uinta Mountains in the northern portion of the Uinta Basin. A small population occurs along Brush Creek on BLM lands. Two populations occur in the Ashley Creek drainage: a small population on private land adjacent to Ashley Creek and a large population in wetlands recently developed in an abandoned gravel pit on Federal lands administered by the Bureau of Reclamation. A large population occurs along the Uinta River and its tributary, the Whiterocks River, primarily on Ute

Distribution of current and historical occurrences of the Ute Ladies'-tresses orchid (*Spiranthes diluvialis*) in Colorado, Nevada, Utah, and Wyoming (Jefferson County, Montana location not shown) as of June 1995.

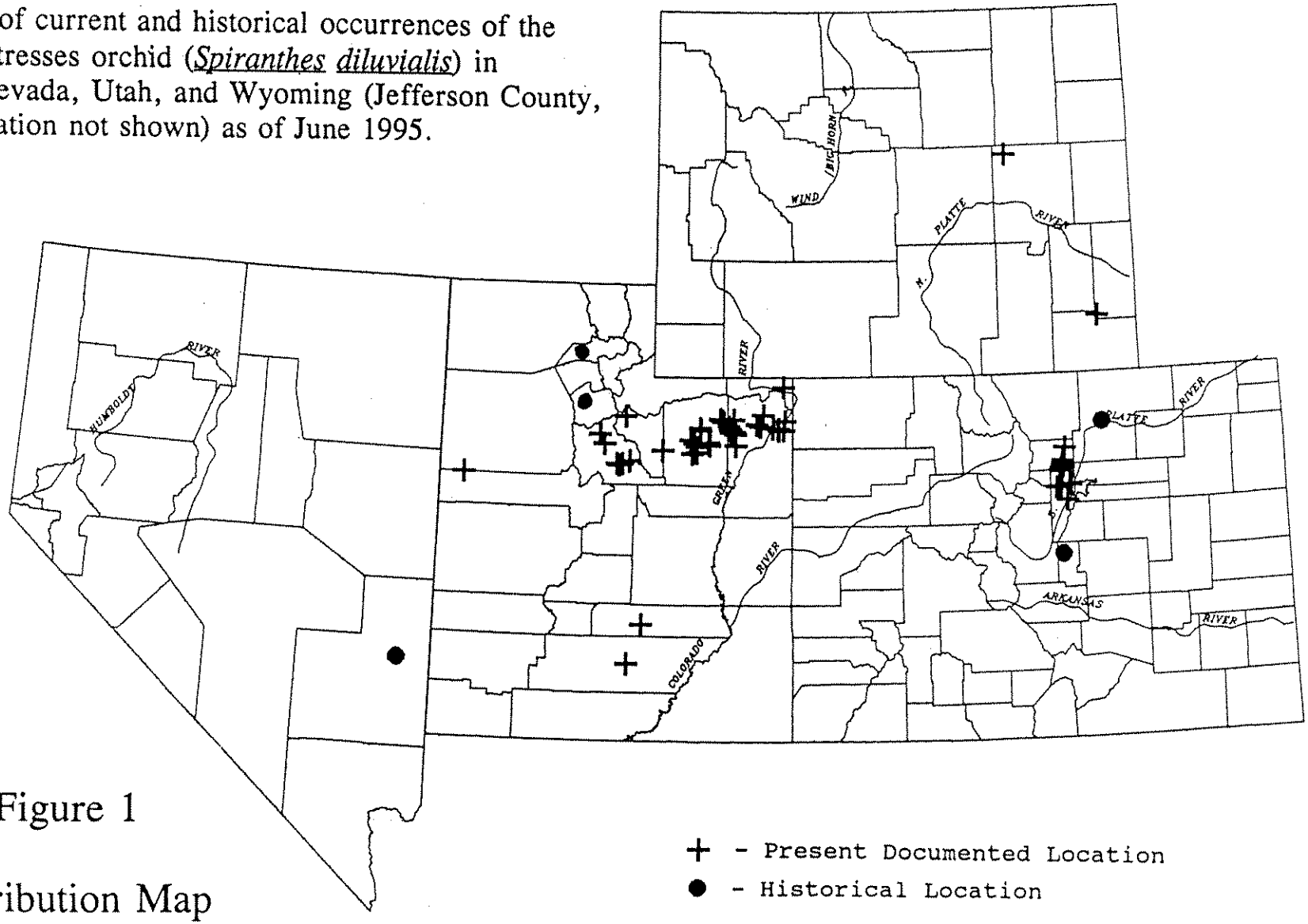

Figure 1

Distribution Map

tribal lands. Populations occur along the Lake Fork River above its confluence with the Yellowstone River, mostly on private lands. A large population occurs along the Duchesne River from the vicinity of its confluence with the Strawberry River upstream to the lower portion of Rock Creek, mostly on private lands. A small population occurs on private lands along Currant Creek, a tributary of the Strawberry River on private land.

Outside of the Uinta Basin, two small outlier populations exist in the Colorado River Basin in south-central Utah. One small population occurs along the Fremont River in Capitol Reef National Park, Wayne County and the second larger population on BLM-administered lands along Deer Creek, near Boulder, Garfield County. All Colorado River Basin populations have been discovered since 1977 (Coyner 1989, 1990; Heil 1988; Jennings 1989; U.S. Fish & Wildlife Service 1991; Franklin 1993).

The western populations of S. diluvialis occur in riparian, spring, and lakeside wet or mesic meadows in the eastern Great Basin of western Utah and adjacent Nevada. Two are in wetlands on private land adjacent to Utah Lake in Utah County, Utah. In 1992, several orchid populations were discovered on the Uinta National Forest in the Spanish Fork River drainage, primarily along the Diamond Fork tributary. Smaller stands occur downstream on private land adjacent to the Spanish Fork River (Stone 1993). In 1993, these locations were revisited and the populations along the Diamond Fork River were found to be quite large (L. Gecy, RMI, in litt. 1994). A small population has been located along the Provo River near Heber City, Wasatch County. A small population occurs at Willow Springs, near the desert community of Callao, Tooele County (D. Stone, Utah Natural Heritage Program, pers. comm., 1994).

Four additional populations are known historically, but are believed to be extirpated. Specimens were collected in Ogden, Weber County, in 1887, but plants have not been relocated. In Salt Lake County, plants were observed in wetlands near the Jordan River as recently as 1953 and in Red Butte Canyon in 1966. Near the town of Panaca, Lincoln County, Nevada, plants were seen in 1936 in a wet meadow in the drainage of Meadow Valley Wash. Recent searches for these populations have been fruitless (Coyner 1989, 1990; Jennings 1989, 1990; U.S. Fish & Wildlife Service 1991; Stone 1993).

The population sizes as of the most recent census are shown in Table 1 for each watershed in which the Ute ladies'-tresses orchid occurs.

In addition to the known range of the species, it is possible that undiscovered populations occur elsewhere in Wyoming (southeastern quarter, along the Green River upstream of Flaming Gorge Reservoir, along the Laramie Divide, along the Powder River and tributaries, and along the Cheyenne River), Colorado (Pawnee grasslands area in the northeast, west slope, especially northwest portion, along the base of the Front Range between Fort Collins and Pueblo), Montana (tributaries to the Missouri River such as the Jefferson and Yellowstone Rivers), and Utah/Nevada/Idaho (Uinta Basin, north of the Wasatch Front along tributaries, such as the Bear River, flowing westward toward the Great Salt Lake or Snake River in Idaho, low elevation wetlands in western Utah and Nevada in similar habitat to the Callao occurrence and the historical occurrence at Panaca).

Table 1. Approximate population size of the Ute ladies'-tresses orchid as indicated by the number of flowering individuals. Numbers are from the most recent censuses available for each watershed.

WATERSHED	POPULATION SIZE
West Desert	1
Duchesne	4,600
Mainstem Green	1,600
Dirty Devil	2
Escalante	500
Utah Lake	7,000
Boulder Creek/St. Vrain	5,500
Clear Creek	1,200
Cache/Poudre River	13
Horse Creek	16
Cheyenne River	24
Jefferson River	71
TOTAL*	20,500

* Rounded to nearest 100

Life History/Demography

Very little is known about the life history and demography of the Ute ladies'-tresses orchid. Research was initiated in 1991 at Dinosaur National Monument and in 1986 at City of Boulder Open Space to learn about life history, demographics, habitat requirements, and habitat management. The following information includes preliminary results from that research and associated literature searches, as well as observations from others who have worked with the orchid over some years.

Orchids generally have very small seeds requiring specific symbiotic associations with mycorhizal fungi for germination (Arditti 1992). Many species of Spiranthes are initially saprophytic, underground plants that persist for many years before leaves emerge above ground. The mycorhizal stage is reported to last for 8 years in Spiranthes spiralis, and green leaves are first produced 11 years after germination (Wells 1967, 1981). The fungal associate may still play an important role in the survival of mature plants. Nutrients derived from a fungal symbiont may allow some orchid species to remain underground without above ground growth for one year or longer. S. spiralis individuals rarely flower in consecutive years or under unfavorable conditions, and may survive due to their relationship with mycorhizal fungi (Wells 1981). Spiranthes diluvialis may have a similar life history (T. Naumann, City of Boulder Open Space Department, pers. comm., 1991). Observations of individually monitored Ute ladies'-tresses orchid plants in Utah and Colorado have demonstrated that a plant can remain dormant (without above ground growth) for at least one growing season (Arft 1993, L. Riedel, National Park Service, in litt., 1993). Studies of Spiranthes magnicamporum in western Kansas and Nebraska report that the orchid may bloom as rarely as once in 20 years (Magrath 1973). The mean expected life span (longevity) of S. spiralis plants studied by Wells over a nine year period was calculated to be more than 50 years.

Vegetative plants average between 10-15 cm in height, but can reach up to 35 cm. The inflorescence begins to emerge in June or July and can reach 12-45 cm tall, producing tubular white flowers arranged in a spiral. The orchid typically begins flowering at the end of July and continues until early September, depending upon moisture and light conditions. Shaded plants tend to flower later. Fruit set occurs in late August through September (Jennings 1990, Arft 1993). At the end of the growing season, small (0.5-2 cm) leaf rosettes often emerge at the base of orchid plants and persist through the winter months. Two or more plants often occur in clumps. It is not known whether these clumps are composed of separate individuals or whether all arise from a single underground organ.

Reproduction appears to be strictly sexual with bumble bees (Bombus species) as the primary pollinators (Dresler 1981, Sheviak 1984, Sipes et al., 1993). Flowers are protandrus (functionally male first and then female). The inflorescence always begins blooming with the bottom flower and proceeds upwards, sequentially. These features tend to maximize outcrossing due to the tendency of bees to visit the bottommost flower first and then proceed vertically up the spike. Successful conservation of the orchid will require

protecting pollinator habitat in and around orchid populations and suitable habitat.

The apparent tendency for populations of the Ute ladies'-tresses orchid to fluctuate dramatically from one year to the next makes it difficult to assess the population status and distribution. Due to the difficulty in finding vegetative individuals, monitoring is typically done by counting the number of flowering individuals. Monitoring at the Van Vleet population by the City of Boulder Open Space Department has been conducted since its discovery in 1986, with the exception of 1991. During that time, apparent population size, as indicated by the number of flowering individuals, has gone from a high of 5,435 in 1986 to a low of 1,137 in 1989 (Arft 1993).

Previous work by Wells (1981) on S. spiralis indicated that population size did not fluctuate when both flowering and vegetative plants were surveyed. Preliminary results examining both vegetative and flowering individuals at the Van Vleet site and Dinosaur National Monument suggest that population size of the Ute ladies'-tresses orchid is more stable than indicated by monitoring only flowering individuals (Arft 1993, Riedel 1992).

Research is necessary to elucidate the early life history stages of the Ute ladies'-tresses orchid (from seed dispersal to seedling emergence and from seedling emergence to mature reproducing individual), identify limiting or vulnerable stages, and understand factors influencing successful completion of each life history stage. No matter what the original cause(s) of reductions in population that resulted in listing as a federally threatened species, improving population status will require identifying vulnerable and limiting life history stages and implementing measures to enhance the successful passage of individuals through those stages (Schemske et al., 1994).

Habitat/Ecology

Spiranthes diluvialis is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. The elevational range of known orchid occurrences is 4,300 and 7,000 feet (Stone 1993). Most of the occurrences are along riparian edges, gravel bars, old oxbows, and moist to wet meadows along perennial streams, but some localities in the eastern Great Basin are in similar situations near freshwater lakes or springs (England 1992). Jennings (1990) and Coyner (1989, 1990) observed that the orchid seems to require "permanent sub-irrigation", indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season and into the late summer or early autumn. This observation has been corroborated by ground water monitoring research conducted in Dinosaur National Monument (Martin & Wagner 1992) and in Boulder, Colorado (T. Naumann, City of Boulder Open Space Department, pers. comm., 1993).

The orchid occurs primarily in areas where the vegetation is relatively open and not overly dense or overgrown (Coyner 1989, 1990 and Jennings 1989, 1990). A few populations in eastern Utah and Colorado are found in riparian woodlands, but the orchid seems generally intolerant of shade, preferring open, grass and forb-dominated sites instead. Plants usually occur as small scattered groups and occupy relatively small areas within the riparian system

(Stone 1993). Common associated species in the eastern range (Colorado's Front Range) of the orchid include Agalinis tenuifolia, Agrostis stolonifera, Asclepias incarnata, Calamagrostis species, Equisetum species, Lobelia siphilitica, Sisyrinchium species, Solidago species, Triglochin species, Verbena hastata, and Cirsium arvense. In the central section of the orchid's range (the Uinta Basin), common associated species are Carex species, Equisetum species, Epipactis gigantea, Calamagrostis species, Oenothera elata, Agrostis stolonifera, Dactylis glomerata, Prunella vulgaris, Cirsium species, Salix exigua, and Solidago canadensis. Species commonly associated with the orchid in the western part of the range (the Wasatch Front and the eastern Great Basin) include Agrostis stolonifera, Alnus incana, Aster hesperius, Carex species, Castilleja exilis, Cirsium arvense, Equisetum laevigatum, Juncus species, Melilotus species, Populus angustifolia, Salix species, Solidago occidentalis, and Trifolium pratense.

Soils typically range from fine silt/sand to gravels and cobbles. The orchid is sometimes found in highly organic or peaty soils. It is not found in heavy or tight clay soils or in extremely saline or alkaline soils (pH >8.0).

The orchid appears to be well adapted to disturbances caused by water movement through floodplains over time (T. Naumann, City of Boulder Open Space Department, pers. comm., 1992, L. Riedel, National Park Service, pers. comm., 1994). It often grows on point bars and other recently created or "raw" riparian habitat. It is tolerant of flooding and flood disturbance. For example, point bars and backwater areas (old oxbows, side channels, etc.) are often flooded for several months in the spring during snowmelt. At least one-third of the Hog Canyon population is buried under flood debris (1 to 8 cm of sandy debris was deposited by an August, 1993 flood) every few years (L. Riedel, National Park Service, pers. comm., 1994).

Once established, the orchid appears to be tolerant of somewhat drier conditions, but loses vigor and may gradually die out if the groundwater table begins to consistently drop during late summer (Riedel 1992, A. Arft, University of Colorado, pers. comm., 1994).

Some of the sites where the orchid occurs have a history of and are currently managed for agricultural uses, typically late winter and early spring grazing and mowing for hay. These sites may be naturally wet meadows or may be supplied with irrigation water.

The habitat alteration resulting from agricultural use (such as from mowing, grazing, and burning) may be beneficial, neutral, or detrimental to the orchid (McClaren and Sundt, 1992). In Colorado, the largest population of the orchid is on City of Boulder Open Space at the Van Vleet site, a floodplain meadow, which has been used agriculturally for the past 50-75 years. This site is still grazed each year in the winter from February to May, mown in the summer around the beginning of July, and irrigated in the spring and early summer. When these activities were discontinued at a similar site in Boulder, exotic species such as Canada thistle (Cirsium arvense) proliferated and the orchid disappeared. Resumption of traditional agricultural uses has since reduced the thistle infestation and the orchid has reappeared (T. Naumann, City of Boulder Open Space Department, pers. comm., 1994). Grazing and mowing seem to

promote flowering, presumably by opening the canopy to admit more sunlight. However, these management practices may impede fruit set by directly removing flowering stalks, enhancing conditions for herbivory of fruits by small mammals such as meadow voles, or altering habitat required by bumble bees, the primary pollinator (Arft 1993).

What is known about the habitat preferences of the Ute ladies'-tresses orchid is consistent with the following model for natural population establishment and maintenance:

> Orchid habitat is found along freshwater streams emerging from the flanks of mountains where the streambed is beginning to level out and meander within a developing floodplain. These streams are very dynamic. They are subject to seasonal flooding from snowmelt and intermittent heavy thunderstorms. Due to variations in snowpack, these streams experience fairly frequent severe (overbank) flooding sufficient to cause movement of the stream channel within its floodplain.
>
> The orchid colonizes early successional riparian habitats such as point bars, sand bars, and low lying gravelly, sandy, or cobbly edges. As the stream channel changes location and depth, the orchid persists in those areas where the hydrology provides continual dampness in the rooting zone throughout the growing season. These areas include old oxbows, side channels, or older stream channels that have been filled in with alluvial material but which still have a hydrologic connection, through groundwater, to the stream system.
>
> The orchid is tolerant of a mix of wetland forb and grass species, is not tolerant of long term standing water, and does not compete with emergent plant species (e.g., cattails) or aggressive species that form dense monocultures such as Canada thistle or reed canarygrass.
>
> Throughout the historical range of the orchid, the lower mountain flanks and associated riparian areas provide winter range for native ungulates. It is likely that late winter and early spring grazing by native ungulates (bison, elk, and deer along the Front Range, big horn sheep, elk, and deer along the south slope of the Uintas and west slope of the Wasatch Range) in riparian areas historically helped maintain the vegetation community in a condition favorable for the orchid (i.e., prevented excessive buildup of live and dead vegetation). Native ungulates typically follow the snowline (greenline) upslope as spring arrives, thus historically did not stay in orchid habitat in large numbers throughout the summer. Predators also likely kept native ungulates from excessive congregation in riparian habitats throughout the year.
>
> As the stream channel continues to change over time, becoming deeper relative to an orchid site due to downcutting or sediment deposition or moving laterally farther away from an orchid site, seasonal hydrology also changes so that an orchid site experiences drier conditions. This causes the vegetation community to become dominated by upland grass and forb species. With time, riparian trees may establish and shade orchid

sites as well. Under these conditions, the orchid is less competitive and begins to die out.

Orchids are expected to be scattered along stream systems and associated floodplain areas with appropriate hydrology. A particular orchid occurrence will persist as long as hydrologic and vegetation community conditions remain favorable. The longevity of an orchid occurrence at any particular location likely ranges from a few years to more than 100 years. Thus, over decades, it may not be possible to determine exactly where an orchid population will be encountered along a stream because the stream channel and associated riparian area will always be changing. However, as long as these dynamic conditions continue, the orchid will dependably occur along the stream system where favorable habitat is found.

As mentioned, the model described above is consistent with what is now known about the habitat preferences of the Ute ladies'-tresses orchid. However, many populations of the orchid, particularly those along the Front Range of Colorado, exist under habitat conditions that are maintained by management activities such as irrigation and grazing rather than by natural stream processes. Many aspects of this model have yet to be verified. It is expected that this model will be refined as new information becomes available through ongoing and proposed research.

Based on this model, the continued existence of the orchid along a stream system requires either (1) direct manipulation of habitat to maintain necessary hydrologic and vegetation community conditions (e.g., by irrigation or stream channel manipulation, and mowing, grazing, or other vegetation management methods) or (2) assurance of the continual creation and evolution of favorable habitat conditions resulting from natural stream dynamics. Of these options, the latter, ensuring the conditions that allow natural stream dynamics to create and maintain preferred orchid habitat, is in the long run the most dependable and ecologically desirable way to guarantee the viability of the orchid in perpetuity.

Reasons for Listing

Orchid species are never common. The Ute ladies'-tresses orchid historically occurred over a wide range but was distributed as scatterings of small populations in suitable habitat within this range. It never dominated local vegetation communities. As previously described, the orchid depends upon natural stream processes, and likely also natural ungulate population levels and behavior, to create and maintain habitat. Both of these environmental features have been dramatically altered since settlement of the west by Europeans. Ungulate populations have been driven from winter range by agricultural activities and urban development. Orchid habitat is now grazed by cows, sheep, or horses, and both timing and intensity are different. Stream processes have also been severely altered. Reservoirs, dams, and diversions have removed water from stream systems, completely dewatering some reaches, and changed their hydrographs (magnitude and timing of flow). Streams have been channelized, streambanks rip-rapped, and floodplains converted for agriculture or urban development. The Ute ladies'-tresses

orchid continues to survive either where streams are still in a somewhat natural condition within a floodplain, or where conditions mimic naturally created and maintained habitat. For example, the orchid can be found along old gravel pits that have been restored as wetlands, in irrigated pastures, and below leaky diversion dams and irrigation canals.

Urbanization is one of the primary threats to the orchid. Urbanization continues to expand along streams and within floodplains. Both undeveloped habitat and agricultural areas near where the orchid exists or where it could exist are being converted to urban and suburban land uses. This is limiting the distribution of habitats sufficient to support viable populations as well as restricting the range of the species. Colorado's Front Range and Utah's Wasatch Front are two of the fastest growing urban areas in the nation. The orchid has been extirpated from some areas along the Wasatch Front and the Front Range. For example, except for two small populations in wetlands near Utah Lake and the recently discovered population along Diamond Fork, all known historic populations of the orchid along the Wasatch Front are presumed extirpated, as are all but one (rediscovered in 1994) in the eastern Great Basin. Two of the four historic populations in Colorado are also extirpated (Coyner 1989, 1990, Jennings 1989, 1990, U.S. Fish and Wildlife Service 1991). The conversion of potential habitat is occurring at a rapid, and increasing, pace.

Increasing demand for water, both for agriculture and for municipal and industrial uses, is also a severe threat to the orchid. In Colorado and Utah, water developers are planning water projects on most of the remaining undammed streams or stream reaches. Water is managed to optimize urban and agricultural uses. Water law and precedent, and water development interests, make it difficult to retain or reinstitute instream flows, particularly flows that mimic or reflect natural hydrographs.

Recreational uses of streams and riparian areas are increasing as nearby urban populations increase. Management of streams for introduced game fish by moderating stream dynamics to produce even rather than varying flows and low sediment loads may impede creation and maintenance of orchid habitat. Recreational uses within riparian areas can trample orchids, cause compaction resulting in changes in hydrology, and encourage proliferation of weedy species. Although it is possible in some cases to manage streams to accommodate both the orchid and recreational activities including game fishing, efforts to do so have not been seriously initiated to date.

Invasion of exotic species into orchid habitat poses a serious threat to the species' viability. The Ute ladies'-tresses orchid does not tolerate dense competing vegetation. In the large populations managed by the City of Boulder Open Space Department, unchecked Canada thistle growth prevents orchids from flowering and reproducing. Other exotic species common to Ute ladies'-tresses orchid habitat that cause similar detrimental effects include purple loosestrife (Lythrum salicaria), whitetop (Cardaria spp.), Russian olive (Eleagnus angustifolia), and reed canarygrass (Phalaris arundinaceae).

The orchid's pattern of distribution as small, scattered, groups and its restricted habitat make it vulnerable to both natural and human-caused

disturbances. Localized catastrophic events have the potential to extirpate individual populations. It is not known if many of the species' smaller scattered populations are of sufficient size to ensure their continued existence over the long term, particularly the populations in Capitol Reef National Park along the Fremont River (2 individuals in 1993), at Willow Springs, Utah (1 individual found) and along Bear Creek in Wyoming (16 individuals).

The Ute ladies'-tresses orchid appears to have a very low reproductive rate under natural conditions (Coyner 1991). Many orchid species take 5 to 10 years to reach reproductive maturity, and this is probably true for S. diluvialis. Reproductively mature plants do not flower every year. These life history and demographic features make the species more vulnerable to the combined impacts of localized extinctions, diminishing potential habitat, increasing distance between populations, and decreasing population sizes (Belovsky et al., 1994).

The present condition of the Ute ladies'-tresses orchid is indicative of the health and condition of watersheds and streams throughout its range. Other species dependent upon the same habitats, for example native fish and amphibian species, are also in trouble. Appropriate watershed and stream management can be beneficial to many species, not just the Ute ladies'-tresses orchid, while improving other watershed functions such as water quality.

Conservation Measures

Many conservation measures have already been undertaken for this rare orchid.

Inventory

Inventories for the species have been or are being conducted in Utah, Colorado, Nevada, and Wyoming. These inventories have resulted in several new discoveries or relocations of historic occurrences, including: every major drainage in the Uinta Basin (Franklin 1993); the Diamond Fork and Spanish Fork rivers (Stone 1993, L. Gecy, RMI, in litt., 1994), and along the Provo River (R. Johnson, Dugway Proving Grounds, pers. comm., 1994) on the Wasatch Front; at Willow Springs in Utah's west desert (eastern Great Basin) (D. Stone, Utah Natural Heritage Program, pers. comm., 1994); along St. Vrain Creek (S. Peterson, Western Resource Development, pers. comm., 1993), upstream in Clear Creek (C. Pague, Colorado Natural Heritage Program, pers. comm., 1993) and in the Cache La Poudre River drainage (K. Manci, City of Fort Collins, in litt., 1993) in Colorado's Front Range; and in the Bear Creek drainage in Wyoming (E. Nelson, Rocky Mountain Herbarium, pers. comm., 1994). These discoveries have improved our understanding of the orchid's historic range and habitat preferences.

Research

The following research projects have been initiated:

1. Pollination biology - USDA Bee Biology and Systematics Laboratory at Utah State University.

2. Seed germination, propagation, and transplanting - University of Colorado and Center for Plant Conservation membership institutions: Red Butte Gardens, Salt Lake City, and Denver Botanic Gardens.

3. Genetic analysis - University of Colorado at Boulder.

4. Demographics and life history - Dinosaur National Monument, City of Boulder Open Space Department, University of Colorado at Boulder, Colorado Natural Areas Program, and Utah Natural Heritage Program.

5. Habitat requirements and management - Dinosaur National Monument, City of Boulder Open Space Department, University of Colorado at Boulder, and Colorado Natural Areas Program.

Management

The Bureau of Land Management, the Forest Service, the National Park Service, and the Bureau of Reclamation all manage lands where the Ute ladies'-tresses orchid grows. The orchid also occurs on Ute tribal land with Bureau of Indian Affairs management responsibilities. These Federal agencies are responsible for insuring that all activities and actions on lands they manage are not likely to jeopardize the continued existence of the Ute ladies'-tresses orchid. The National Park Service and the Bureau of Land Management have initiated population monitoring. The Forest Service is preparing a Conservation Agreement for the Diamond Fork area.

The National Park Service has supported orchid research and special management projects in Dinosaur National Monument since 1990. A population biology study and habitat restoration project is ongoing in a significant occurrence (Hog Canyon) of the Ute ladies'-tresses orchid in the Cub Creek drainage in eastern Utah. Orchid population dynamics are being studied through long-term monitoring of several hundred permanently marked plants. Research investigating the relationship between ground water level, stream water level, soil moisture and orchid presence and viability is ongoing. The small perennial tributary to Cub Creek which provides orchid habitat has been restored to a natural position within its floodplain where the orchid occurs. The restoration project focuses on a stream section that was artificially incised early in the century. Pre- and post- stream relocation data have been collected to monitor the effects of habitat restoration on the orchid. The National Park Service in cooperation with other agencies expects to continue long-term orchid monitoring and inventory in Dinosaur National Monument.

The City of Boulder Open Space Department actively manages for the Ute ladies'-tresses orchid in areas where it is known or expected to occur. Management activities include: restricting the use of chemicals and using integrated weed management (biological control, late spring grazing) on exotic species that encroach on or threaten orchid habitat; retaining and monitoring the impact of historic agricultural practices such as grazing, irrigation, and haying; and maintaining a separate layer in the GIS computer system on orchid locations to aid in planning Open Space activities. The Open Space Department supports monitoring and research activities including annual surveys of potential habitat and annual population counts. In addition, the Open Space

Department provides support for graduate research on demographics, genetics, and environmental requirements of the orchid and conducts educational programs about the orchid for local organizations, school groups, and public citizens.

Mitigation and habitat rehabilitation associated with the Central Utah Project may provide opportunities for protecting, enhancing, or recreating orchid habitat and providing suitable sites for reintroduction.

Regulation

In 1992, The U.S. Fish and Wildlife Service developed interim survey requirements for selected areas of Colorado. These requirements stated that all projects requiring a Federal permit or receiving Federal funding that may disturb potential orchid habitat must be surveyed for the presence of the orchid. As a result of these requirements, three additional occurrences were discovered, along the St. Vrain River, in the Cache La Poudre River drainage near Fort Collins, and farther upstream along Clear Creek. These new occurrences are all within the known historical range of the species, but significantly extend the current range.

The U.S. Fish and Wildlife Service in Utah has also required surveys for the orchid on a site by site basis. Surveys in association with the Central Utah Project have led to the discovery of the Provo River population and provided additional information on the population size and distribution along the Diamond Fork and Spanish Fork Rivers.

The survey requirements in Utah and Colorado have helped ensure that unknown occurrences are not inadvertently destroyed.

In 1995, the Service developed guidance for fulfilling Section 7 consultation responsibilities and working with partners to conduct surveys in priority areas in all the states where the orchid is or has been known to occur or where it is suspected that new discoveries are possible. The guidance is based on watershed units and is designed to ensure that Service procedures are consistent throughout the range of the orchid.

As a member of the family Orchidaceae, S. diluvialis is included on Appendix II of CITES. Species on Appendix II require a permit from the country of origin prior to export. International trade in this species is likely minimal.

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