Status Review of the

Ute ladies tresses

(*Spiranthes diluvialis*)

in Wyoming

Prepared for the
Wyoming Cooperative Fish and Wildlife Research Unit,
US Fish and Wildlife Service, and Wyoming Game and Fish Department

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INTRODUCTION

Ute ladies tresses (*Spiranthes diluvialis*) was first collected by Marcus E. Jones in Salt Lake City, Utah in August 1880. Jones' specimen was initially identified as *S. romanzoffiana*, a widespread Cordilleran species, but was later referred to *S. cernua* by Correll (1950). While revising the taxonomy of the genus *Spiranthes* in the early 1980s, Charles Sheviak (1984) recognized that the Jones specimen and several others from eastern Nevada, western Utah, and northern Colorado belonged to an undescribed species that he named *S. diluvialis* in 1984.

Due to its apparent global rarity and documented habitat loss, Ute ladies tresses was listed as Threatened under the Endangered Species Act in 1992 (US Fish and Wildlife Service 1992). In 1993, B. Ernie Nelson of the University of Wyoming's Rocky Mountain Herbarium (RM) discovered the first population of *Spiranthes diluvialis* in Wyoming (Fertig 1994). Over the next four years, three additional populations were found in Wyoming (Hartman and Nelson 1994; Hazlett 1996, 1997) and new populations were discovered in Idaho (Moseley 1997), Montana (Heidel 1996), Nebraska (Hazlett 1996), and Washington (Washington Natural Heritage Program 1999). Rangewide, *S. diluvialis* is now known from over 60 locations representing at least 30 distinct biological populations.

The US Fish and Wildlife Service (USFWS) has been petitioned to de-list the Ute ladies tresses and is also in the process of re-evaluating recovery and conservation objectives for this species in light of new discoveries in the past decade (Lucy Jordan, USFWS, memo dated 4 October 1999). As part of this effort, the USFWS contracted with the University of Wyoming and the Wyoming Natural Diversity Database (WYNDD) in 1999 to summarize known information on the abundance, distribution, habitat, and potential management needs of *Spiranthes diluvialis* in Wyoming. The results of this analysis are included in this report.

METHODS

Information on the habitat and distribution of *Spiranthes diluvialis* in Wyoming was obtained from scientific literature, unpublished reports, specimens from the Rocky Mountain Herbarium (RM), and field surveys conducted by RM and WYNDD staff and private consultants in southeastern and western Wyoming from 1993-1999.

SPECIES INFORMATION

Classification:

Scientific Name: *Spiranthes diluvialis* Sheviak (1984).
Common Name: Ute ladies tresses.
Family: Orchidaceae (Orchid family).
Synonyms: *Spiranthes romanzoffiana* Cham. var. *diluvialis* (Sheviak) Welsh (Welsh et al. 1993).
Phylogenetic Relationships: As currently defined, the genus *Spiranthes* contains approximately 40 species centered in North America, but also extending to South

America, Japan, and Australia (Wilken and Jennings 1993). Based on morphology and genetics, Sheviak (1984) postulated that *Spiranthes diluvialis* was an allopolyploid (2n = 74) derived from hybridization between *S. romanzoffiana* (2n = 44) and *S. magnicamporum* (2n = 30). (Allopolyploids are derived from hybridization between 2 genetically distinct diploid species, followed by chromosome doubling which allows the hybrids to be fertile but no longer cross-compatible with their progenitor species.) Detailed isozyme studies by Arft and Ranker (1998) confirmed Sheviak's hypothesis. In addition, Arft and Ranker found an unexpectedly high degree of genetic variability in populations of *S. diluvialis*, from Colorado and Utah suggesting that the species may have evolved from at least two separate hybridization events. A comparable genetic survey of populations in Nebraska, Wyoming, Idaho, and Montana in 1999, however, found little genetic variablity between populations (Gerry Steinauer, pers. comm.). The ranges of *S. romanzoffiana* and *S. magnicamporum* do not currently overlap, suggesting that hybridization may have occurred during the Pleistocene when their ranges shifted in response to glacial advances (Sheviak 1984).

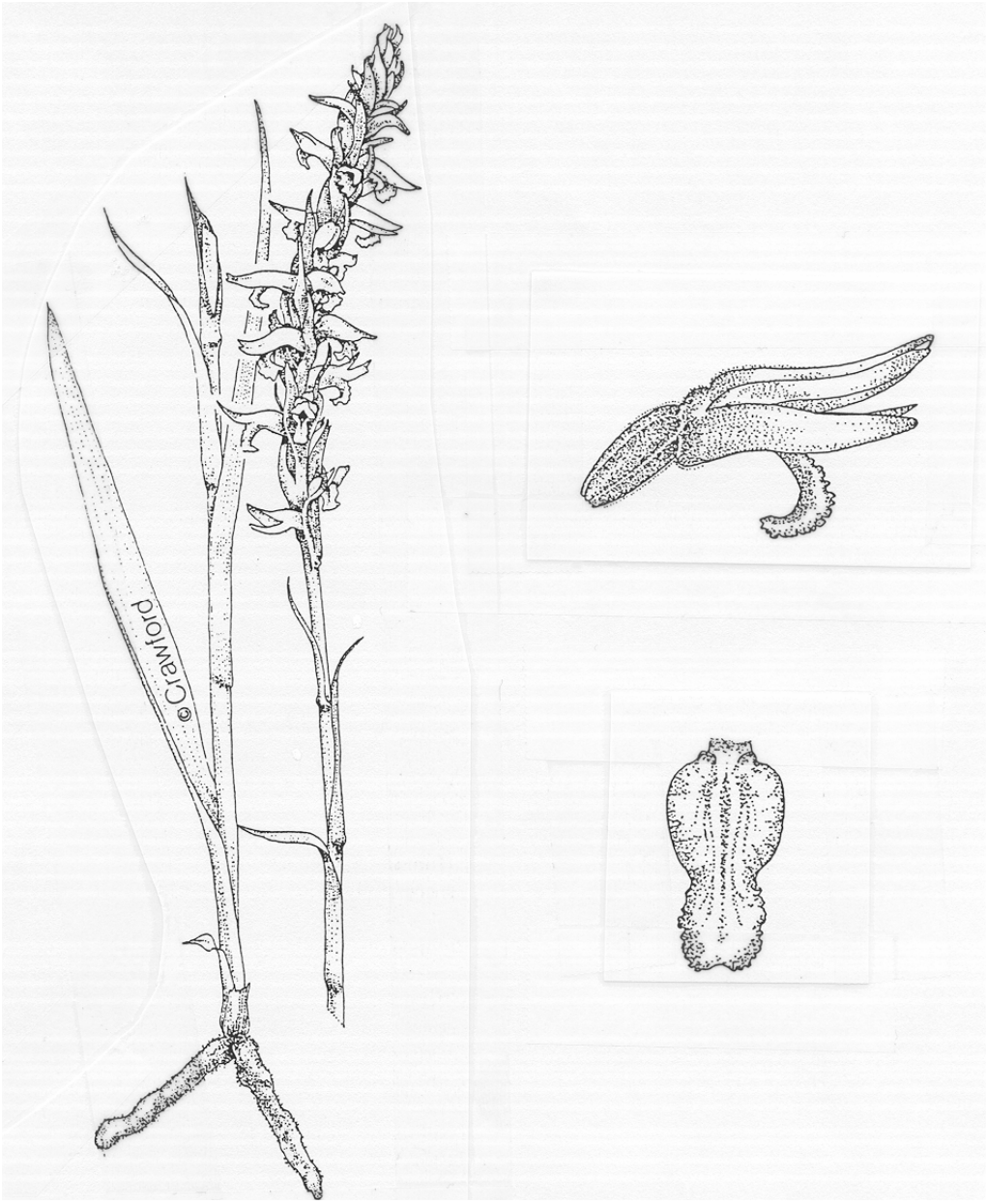
Legal Status: The Ute ladies tresses was listed as Threatened under the US Endangered Species Act on 17 January 1992 (US Fish and Wildlife Service 1992). *Spiranthes diluvialis* is also listed on Appendix II of the Convention on the International Trade in Endangered Species (CITES) and is protected from illegal export (US Fish and Wildlife Service 1995). This species receives no formal protection under Wyoming state law.

Natural Heritage Rank: The network of natural heritage programs gives *Spiranthes diluvialis* a rank of G2, indicating that the species is "imperiled because of extreme rarity". Species ranked G2 typically are known from 20 or fewer extant occurrences, or have small populations subject to high threat. Moseley (1998a) has recommended that this rank be changed to G3 ("rare or uncommon, but not imperiled" and typically known from 21-100 extant locations) based on recent surveys in the western United States. *Spiranthes diluvialis* is currently ranked S1 (critically imperiled) in Wyoming, indicating that the plant is known from fewer than 5 extant populations and a small population size (Fertig and Beauvais 1999).

Description: Ute ladies tresses is a perennial herb with erect, glandular-pubescent stems 12-50 cm tall arising from tuberous-thickened roots (Fig. 1). Basal leaves are linear, up to 1 cm wide and 28 cm long, and persist at flowering time. Leaves become progressively reduced higher up the stem. The inflorescence is a loose spike 3-15 cm long of numerous, small white to ivory flowers arranged in a gradual spiral. The lip petal is oval to lance-shaped, narrowed at the middle, and has crispy-wavy margins. Sepals are free or fused only at the base (not forming a hood-like structure) and are often spreading at their tips (Fertig et al. 1994; US Fish and Wildlife Service 1995).

Similar Species: *Spiranthes romanzoffiana* has deeply constricted lip petals, sepals fused for at least 1/2 their length into a hood-like tube, and a densely congested inflorescence and

Figure 1. Line drawing of *Spiranthes diluvialis* from Fertig (1994). Illustration by Carolyn Crawford.



typically occurs in montane wetlands. *S. magnicamporum*, a prairie species not currently known from Wyoming, has strap-shaped, wavy-margined lip petals and lacks leaves at flowering time. *S. porrifolia* (also not known from Wyoming) has yellowish flowers with sepals fused for about 1/2 their length (but not forming a hood), and strap-shaped lip petals with peg-like projections near the tip (Moseley 1998a). *Habenaria* [*Platanthera*] *dilatata* has a more elongate inflorescence, broader leaves, and white flowers with an elongated spur on the back of the lip petal.

Geographic Range: Ute ladies tresses currently is known from western Nebraska, southeastern Wyoming, north-central Colorado, northeastern and southern Utah, east-central Idaho, southwestern Montana, and north-central Washington (Moseley 1998a). An historical population is also known from south-central Nevada. In Wyoming, *Spiranthes diluvialis* occurs at four locations on the Western Great Plains in Converse, Goshen, Laramie, and Niobrara counties (Fig. 2). These populations are found in the Horse and Bear Creek drainages (tributaries of the North Platte River), Antelope Creek drainage (a tributary of the Cheyenne River), and along the Niobrara River. An additional report from Uinta County is based on a misidentifed specimen of *Spiranthes romanzoffiana* (Jennings and Fertig 1995).

Extent of Surveys in Wyoming: Formal surveys for *Spiranthes diluvialis* began in Wyoming in 1994, one year after B. Ernie Nelson, manager of the RM, discovered the state's first population in Goshen County. Nelson and RM staff and graduate students have conducted general floristic surveys in southeast Wyoming, the Green River Basin, and Laramie Basin from 1994-1999, finding one new colony in Converse County in 1994 (Hartman and Nelson 1994). Don Hazlett, a botanical consultant under contract to the BLM, surveyed public and private lands in southeast Wyoming and Nebraska from 1995-1997 and discovered new populations in Niobrara and Laramie counties (Hazlett 1996, 1997). Walter Fertig and George Jones of WYNDD surveyed public lands in Jackson Hole and the lower Green River Basin in 1999, but did not find any new *S. diluvialis* sites (Jones 2000a, 2000b, in prep). WYNDD staff also conducted unsuccessful searches in the Powder River Basin, National Elk Refuge, and F.E. Warren Air Force Base (1995-1997) (Fertig 1995a, 1995b, 1998). Various environmental consulting firms have been searching for *Spiranthes* across the state since 1994, but have not documented new colonies.

Additional potential habitat may exist for *Spiranthes diluvialis* in the northern Great Plains, along the eastern edge of the Bighorn Range, or in the Bighorn Basin. More habitat may also exist along small streams on private lands in southeastern Wyoming. Because of the plant's irregular flowering pattern, sites that have been "cleared" in the past could still support populations (Moseley 1998a).

Habitat: Rangewide, *Spiranthes diluvialis* occurs primarily on moist, subirrrigated or seasonally flooded soils in valley bottoms, gravel bars, old oxbows, or floodplains bordering springs, lakes, rivers, or perennial streams at elevations between 550-2075 m (1800-6800 ft) (Arft and Ranker 1998; Moseley 1998 a). Soils vary from sandy or coarse cobbley alluvium to calcareous, histic, or fine-textured clays and loams. Populations have been documented from alkaline sedge meadows dominated by *Carex aquatilis, C. praegracilis,* and *C.*

Figure 2. Distribution of *Spiranthes diluvialis* in Wyoming.

lanuginosa (Heidel 1998), *Eleocharis rostellata, Elaeagnus commutata/Agrostis stolonifera, Salix exigua/Agrostis stolonifera*, and *Equisetum variegatum* cover types within riverine floodplains (Moseley 1998a, 1998b), flooded alkaline meadows adjacent to *Pinus ponderosa/ Pseudotsuga menziesii* woodlands and sagebrush steppe (Washington Natural Heritage Program 1999), and streamside floodplains and meadows on alluvium (Spackman et al 1997; Stone 1998). Some occurrences are also found on agricultural lands managed for winter or early season grazing or hay production (Hazlett 1996, 1997). Known sites often have low vegetative cover and may be subjected to periodic disturbances (flooding, or grazing). Populations are often dynamic and "move" within a watershed as disturbances create new habitat or succession eliminates old habitat (US Fish and Wildlife Service 1995; Moseley 1998b).

In Wyoming, *Spiranthes diluvialis* is found mostly on low, flat floodplain terraces or abandoned oxbows within 0.5-15 m of a small stream. These sites are subirrigated and seasonally flooded, remaining moist into the summer. The Converse County population (EO # 002) differs in being on a steep (45°) south-facing slope of a low terrace. Soils range from alluvial sand and coarse silt to whitish loamy-clays with a pH between 7.7-7.8 (Steinauer and Hildebrand 1998). These soils are derived from Quaternary alluvial deposits, or in Converse County, from drab sandstones and claystones of the Eocene Wasatch Formation (Love and Christiansen 1985). Wyoming populations range in elevation from 1415-1650 m (4650-5420 ft).

Ute ladies tresses populations in Wyoming occur in moist meadow communities dominated by *Agrostis stolonifera, Elymus repens, Juncus balticus, Panicum virgatum,* and *Hordeum jubatum* within a narrow band between emergent aquatic vegetation and adjacent dry upland prairie. Vegetative cover is typically 75-90%, but is usually short (under 45 cm tall). The Converse County population is somewhat anomalous in that it occurs at the edge of a cattail marsh among tall, dense grasses. Common associated species include *Equisetum laevigatum, Glycyrrhiza lepidota, Melilotus officinalis, M. albus, Muhlenbergia asperifolia, Juncus nodosus, Triglochin maritimum, Pedicularis crenulata, Sisyrinchium angustifolium,* and *Scirpus pungens* (see Table 1 for complete list). Exotic plants contribute a high amount of total cover (especially *Agrostis stolonifera, Elymus repens,* and *Melilotus albus*).

Average annual precipitation within the range of *Spiranthes diluvialis* in Wyoming varies from 305-406 mm (12-16 in), with peak precipitation coming in May and June. Mean annual temperature ranges from 6.6-7.7° C (44-46° F). Mean maximum and minimum temperatures in January are 1.1-3.3° C (34-38° F) and -7.6 to -9.9° C (10-14° F). Mean maximum and minimum temperatures in July are 29.7-30.8° C (86-88°) and 12.1-13.2° C (54-56°) (Martner 1986).

Population Size and Trends: Ute ladies tresses is presently known from four populations in Wyoming, all discovered between 1993-1997. In 1998-1999 I revisited all four of these populations and documented 800-1200 individuals in a total area of less than 4 hectares (10

Table 1.
Vascular Plant Species Associated with *Spiranthes diluvialis* in Wyoming

From: Hartman and Nelson (1994), Hazlett (1996, 1997), and 1998-99 surveys by W. Fertig

! Agalinis tenuifolia var. *parviflora*
** Agrostis stolonifera*
Alisma triviale
Ambrosia trifida
Aster ericoides var. *pansus*
Aster falcatus
Atriplex subspicata
Bidens comosa
Bidens frondosa
** Bromus inermis*
Calamagrostis inexpansa
Carex lanuginosa
Carex nebrascensis
Chenopodium rubrum var. *rubrum*
Cirsium canescens
! Cuscuta indecora
Deschampsia cespitosa
Echinochloa muricata var. *microstachya*
Eleocharis quinqueflora
Elymus canadensis
Elymus lanceolatus
** Elymus repens*
Epilobium palustre var. *gracile*
Equisetum laevigatum
Erigeron lonchophyllus
Habenaria [*Platanthera*] *dilatata*
Helianthus nuttallii
Hordeum jubatum
Galium trifidum
Gentianella amarella
Glycyrrhiza lepidota
Juncus balticus
Juncus longistylis
Juncus nodosus
Juncus torreyi
Lycopus americanus
Lycopus asper
** Medicago lupulina*
** Melilotus albus*
** Melilotus officinalis*
Muhlenbergia asperifolia
Orthocarpus luteus
Panicum virgatum
Parnassia palustris var. *montanensis*
Pedicularis crenulata
** Phleum pratense*
** Plantago major*
Polygonum ramosissimum
Ranunculus cymbalaria var. *cymbalaria*
Salix spp.
Scirpus pungens var. *polyphyllus*
Scirpus validus
Sium suave
Sisyrinchium angustifolium
Sisyrinchium montanum
Solidago canadensis var. *gilvocanescens*
** Sonchus uliginosus*
Sparganium emersum
Spartina gracilis
Stachys palustris var. *pilosa*
Suaeda calceoliformis
Thelypodium integrifolium
** Trifolium pratense*
Triglochin maritimum var. *elatum*
Typha latifolia

! Rare species in Wyoming
* Exotic species

Table 2.
Abundance and Trend Information for Known Populations of
Spiranthes diluvialis in Wyoming

Occ. #	Location*/ Owner/Voucher Specimen	Population Size	Trend
WY-001	Goshen County: along Bear Creek ca 0.25 miles above Little Bear Creek on County Road 153, ca 14.3 miles SE of Chugwater. Owner: State of Wyoming Voucher: Nelson, B.E. 28597 (RM)	1999-08-09: 200 flowering and vegetative plants observed by W. Fertig, G. Jones, B.E. Nelson, and B. Schladweiler. Density of 4-8 plants/sq meter observed at best sites. Total population estimated at 500 along entire stream. 1998-08-17: 70 plants observed at 2 sites by Fertig. Population estimated at 300-500. 1998-08-03: 214 flowering and vegetative plants observed by J. Carroll, M. Jennings, D. felley, D. Hazlett, and D. Young. 1997-08-30: Population estimated at 500 plants by T. Hildebrand. 1994-08: Ca 100 plants observed by B.E. Nelson and T. Chumley. 1993-08-17: 4 plants observed in brief visit by B.E. Nelson.	Stable to Increasing
WY-002	Converse County: tributary of Antelope Creek, ca 3 air miles SW of Ross. Owner: BLM Casper Field Office Voucher: Nelson, B.E. (s.n.) (RM)	1999-07-22: 12-15 vegetative plants observed by Brenda Schladweiler. 1998-08-19: 20 flowering plants observed by W. Fertig. 1997-08-15: 35 plants observed by T. Hildebrand. 1995-08-17: 11 plants observed by P. Wolken. 1994-08-21: Ca 20-24 flowering and vegetative plants observed by B.E. Nelson.	Stable?
WY-003	Niobrara County: “between Lusk and Van Tassell”. Owner: private. Voucher: Hazlett, D. 9538 (COLO, RM)	1998-08-18: 203 plants counted by W. Fertig in 3 main colonies (surveyed with consent of landowner). 1996-08-17: 57 plants observed in 5 colonies by D. Hazlett. Reported as “sporadic”.	Stable to increasing
WY-004	Laramie County: “vicinity of Midway and Meriden”. Owner: private Voucher: Hazlett, D. 10158 (RM)	1998-08-18: ca 400 plants observed by W. Fertig (with permission of landowner). 1998-08-03: 454 plants observed by J. Carroll and USFWS tour group. 1997-09-04: 71 plants observed by D. Hazlett	Stable to increasing

* Under state law WYNDD is not allowed to divulge information on the exact location of plant and animal populations on private lands without landowner consent.

acres). Populations ranged in size from 12-35 individuals in Converse County to 450-500 plants at sites in Goshen and Laramie counties (Table 2).

Short-term trend data suggest that Wyoming populations are stable to increasing (Table 2). Such an interpretation should be made with caution, however, as increases could be an artifact of more thorough survey efforts or the result of annual fluctuations in the number of reproductive individuals (the plants most likely to be observed in a survey). Population fluctuations have been observed at several locations rangewide, including two occurrences in Idaho that "disappeared" between 1997 and 1998, even though the habitat was not altered (Moseley 1998b). Such dramatic changes may be less significant than they appear if dormant, below-ground individuals were to be counted (Moseley 1998a).

Population Biology and Ecology: Ute ladies tresses populations in Wyoming typically occur at low densities, with no more than 4-8 flowering or vegetative plants per square meter at favorable microsites. This number could be higher, however, if below-ground dormant individuals were included. Wyoming plants exhibit a clumped, non-random distribution pattern and do not occupy all of their available habitat. The percentage of flowering individuals is usually at least 50%.

In Wyoming, *Spiranthes diluvialis* blooms from early August to early September, with fruits produced in mid August to September. No direct observations of pollination have been made in the state. Sipes and Tepedino (1994) report that large, long-tongued bumblebees in the genus *Bombus* are the primary pollinators in Utah and Colorado. Smaller bees may also visit these flowers but have the incorrect body shape or mass to properly accommodate the flower's large, sticky anther/pollen clusters (pollinaria). Out-crossing in Utes ladies tresses is promoted by the asynchronous maturation of anthers and pistils in individual flowers. *Bombus* typically visit the oldest basal flowers of an inflorescence first (these are by then functionally pistillate) and pick up pollinaria from younger (functionally staminate) flowers at the tip of the inflorescence. These pollinaria are then delivered to the basal pistillate flowers of the next inflorescence they visit (Sipes and Tepedino 1994). Some overlap in the maturation of staminate and pistillate flowers can occur within the same inflorescence, allowing for low rates of self-pollination. *S. diluvialis* may also be capable of agamospermy (a form of asexual reproduction in which seeds are produced without fertilization), as has been docmented in its parental taxon, *S. magnicamporum* (Sipes and Tepedino 1994). Heidel (1998) has reported potential asexual reproduction by broken tuberous root segments.

Spiranthes diluvialis can produce as many as 7300 tiny seeds per fruit. Seedlings may persist for up to 8 years as subterranean saprophytes dependent on mycorrhizal fungi (Heidel 1998). Small, inconspicuous leaf rosettes may emerge at the end of the growing season and overwinter (Arft 1995). Individual plants may not flower in consecutive years or under adverse environmental conditions and persist below ground with their mycorrhizal symbionts (Arft 1995). The related species, *S. magnicamporum* may flower only once in 20 years (US Fish and Wildlife Service 1995). Life expectancy for at least one *Spiranthes* species has been estimated at more than 50 years (Heidel 1998).

ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Current Management: Populations in Goshen and Converse counties occur on state and public lands (BLM Casper Field Office) leased for cattle and horse grazing. The intensity of grazing may vary from year to year, with heavy use observed at the Goshen County site immediately after the discovery of this species in 1993. In recent years, grazing intensity has been more moderate. The Converse County site was grazed by sheep until the early 1980s and is now grazed by cattle from September to December (T. Hildebrand, pers. comm.). Populations in Niobrara and Laramie counties occur on private lands managed for hay production. Mowing has kept competing vegetation low, and both populations appear to be thriving. None of the Wyoming populations are currently under conservation easement or other formal or informal special management designation.

Existing and Potential Threats: Wyoming populations of Ute ladies tresses are largely unthreatened under current management, but all could become threatened by changes in land use. The following potential threats have been identified in the literature:

1. Urbanization: At least five populations in Colorado and Utah have been extirpated due to habitat loss stemming from urban sprawl in the Colorado Front Range and Wasatch Front (Arft 1995; US Fish and Wildlife Service 1995). Remaining populations in these areas are all small and highly vulnerable to continued habitat loss or degradation that could result from incresased recreational use or the spread of competing weeds (US Fish and Wildlife Service 1995). The remoteness of the Wyoming populations makes them unlikely to be destroyed by urbanization in the foreseeable future, although some areas on private lands could be developed for new rural homesites.

2. Grazing: Ute ladies tresses is edible to livestock and depressed inflorescence and fruit production have been observed at sites that are grazed in late sumer (Arft 1995). Grazing has been shown to be beneficial, however, in reducing the cover of competiting vegetation, especially when it is done in the early summer before *Spiranthes diluvialis* produces flowers or fruits (Arft 1995; Moseley 1998b). Grazing may mimic the effects of flooding, fire, or other disturbances in maintaining low vegetative cover or reducing weed cover (Moseley 1998b). At least two populations in Idaho and Colorado have been grazed for over 75 years and still support large populations of Ute ladies tresses (Arft 1995; Moseley 1998b). Some effects of grazing are still poorly known, particularly the relationship between grazing intensity and the establishment of *Agrostis stolonifera* (a dominant introduced species at several sites in Idaho and Wyoming) and the impacts of grazing and trampling on the life history of insect pollinators (Arft 1995; Moselely 1998b).

Grazing is the primary land use at two of the state's populations (Converse and Goshen counties). The Converse County population is noteworthy in that it is grazed in late summer and fall, at the end of the flowering and fruiting season. The small size of this colony may be due to poor seed production resulting from grazing of fruiting stalks (although the site may also be marginal habitat due to its unusual soil and topographic characteristics). Atypically high levels of summer grazing and drought in 1994 resulted in few flowering

plants being observed at the Goshen County site (B.E. Nelson, pers. comm.), although the population and range condition has since recovered under more moderate grazing use. Overall, the impacts of grazing on Ute ladies tresses in Wyoming has been low.

3. Mowing: As with grazing, mowing can be beneficial to Ute ladies tresses populations by reducing competing vegetation cover, but can be detrimental if done before fruit have ripened, or if the height of cutting is too low (Arft 1995; Hazlett 1996, 1997). Late season mowing (after fruit have ripened) may be one of the best management tools available for maintaining the habitat of this species. Under current management, the timing of mowing is related to growth conditions of the hay crop and weather patterns rather than the biological needs of Ute ladies tresses. Good fruit crops of *Spiranthes* may occur in years when mowing is delayed until late summer, or when moisture conditions permit an early and late cut. Mowing has little impact on vegetative plants and probably has not resulted in a net population decline.

4. Flood Control: Populations along large rivers in Idaho and Utah may be negatively affected by flood control measures (Moselely 1998b). Without this periodic source of disturbance, sparsely vegetated *Spiranthes* habitat may become replaced by dense shrub stands. Flood control is not a concern in Wyoming as our populations are all found on small, mostly unregulated streams.

5. Pesticides: *Spiranthes diluvialis* may be susceptible to broadleaf herbicides applied in hay meadows. More significantly, the plant's pollinators may be vulnerable to insecticides used in control of grasshoppers and other pests on range lands (Sipes and Tepedino 1994). Excessive pesticide use does not appear to be a problem under current management at sites in Wyoming.

6. Competition from Introduced Weeds: In Idaho, introduced plant species may contribute 33-109% of the cumulative vegetative cover in some *Spiranthes diluvialis* populations (Moselely 1998b). Many of these weeds, such as *Cirsium arvense, Centaurea maculosa,* and *Elaeagnus angustifolia* can be aggressive and ultimately displace native species. Less well-known are the impacts of introduced sod-forming grasses such as *Agrostis stolonifera* and *Poa pratensis* on the structure and species composition of floodplain plant communities (Moseley 1998b). Exotics are a relatively small component of the flora of *Spiranthes* populations in Wyoming (Table 1) but can be locally dominant (especially *Agrostis stolonifera, Elymus repens,* and *Melilotus albus*).

7. Natural Herbivory: Arft (1995) found that herbivory by voles (*Microtus* spp.) was a significant source of inflorescence destruction at a grazed and mowed site near Boulder, Colorado. Reduction of cover or an increase in meso-predators (foxes, skunks, weasels) could help control vole numbers and thus increase *Spiranthes* fruit production. Similar impacts from voles have not been reported at other sites, although grazing by deer has been documented by one private landowner in Wyoming.

8. Loss of Pollinators: As previously mentioned, insecticides can lead to mortality of the

bumblebee pollinators of Ute ladies tresses and reduced seed production. Other management actions, such as flooding, fire, or mowing, could have potentially negative impacts on pollinators (Sipes and Tepedino 1994). Management plans for *Spiranthes diluvialis* should take into account the habitat needs of its pollinators, including adequate availability of other flowering plants for food and sites for nest establishment (Sipes and Tepedino 1994). Little is currently known about the identity and life history of these pollinators in Wyoming.

9. Recreation: High recreation use (fishing access, camping, and hiking) have been noted at sites in Idaho and Colorado, but the overall impacts on this species appear low. Land ownership patterns and the remoteness of the Wyoming sites makes recreation a negligible threat at present.

9. Over-collection: Many orchid species worldwide are vulnerable to over-harvest by collectors. This has not been reported for *Spiranthes diluvialis* in Wyoming.

Management Recommendations: To ensure the continued survival of Ute ladies tresses in Wyoming, the follwoing actions are recommended:

1. Maintain Current, Compatible Land Uses on Private and Leased Public Lands: The survival of Ute ladies tresses populations in Wyoming will depend on the continuation of compatible agricultural activities within occupied habitat. This may entail modifying the timing of current grazing and mowing schedules so as to minimize impacts during peak fruiting periods in late August. Continuation of grazing and mowing cycles in early spring or late summer (after fruit have ripened) will help ensure that the low cover conditions favored by *Spiranthes diluvialis* will be maintained. The application of herbicides and insecticides in occupied Ute ladies tresses habitat may also need to be controlled.

Incentive programs need to be developed to encourage private landowners and leaseholders to continue or modify compatible management techniques for the enhancement of Ute ladies tresses habitat. Financial compensation would help defray costs incurred by private individuals to manage this species and would ensure greater cooperation between landowners, federal agencies, and private conservation groups. Monetary awards could come from existing agricultural support programs (such as those administered by the Natural Resources Conservation Service), new funding sources (such as the proposed Conservation and Reinvestment Act), income or estate tax relief (through conservation easements), or compensation from private conservation organizations. Incentives could also come through public recognition and rewards for good stewardship. County-wide or regional Habitat Conservation Plans could also provide stewardship incentives.

2. Continue Survey and Research Programs: Surveys of potential *Spiranthes diluvialis* habitat throughout the west since 1992 have lead to the discovery of numerous new populations and have forced a reassessment of its conservation status. High-quality sites that have been previously "cleared" of this species may still need to be resurveyed periodically on the chance that this species was not flowering or emergent during earlier

visits. Research into the population genetics, pollination biology, and management responses of this plant should be continued to help refine management goals and objectives. Finally, this species should be considered for de-listing if it is proven to be sufficiently abundant or protected rangewide.

Summary: Ute ladies tresses was recognized as a distinct species in 1984 and listed as Threatened under the US Endangered Species Act in 1992. The following year, this species was discovered for the first time in Wyoming. It has since been located at three other sites in the state and nearly 60 locations (representing at least 30 distinct biological populations) in Utah, Colorado, Nebraska, Montana, Idaho, and Washington. In Wyoming, Ute ladies tresses occurs on terraces, floodplains, low slopes, and oxbows adjacent to small streams on sandy or coarse gravel alluvium or alkaline clays. Populations occur in wet meadow communities dominated by *Agrostis stolonifera, Elymus repens, Juncus balticus, Panicum virgatum,* and *Hordeum jubatum* at elevations of 1415-1650 m. Surveys in 1998-1999 found 800-1200 individuals at the four sites in Wyoming. Based on short-term observation data, these populations all appear stable or increasing. All of these sites are on private, state, or BLM lands managed for livestock grazing or hay production. Current land uses appear compatible with the habitat needs of Ute ladies tresses, although the timing of grazing and mowing may be critical.

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