Effects Of Interbasin Water Transport on

Ecosystems Of Spring Valley,

White Pine County, Nevada

24 June 2006

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Location and Physical Setting of Ecosystems

Spring Valley is a large, high valley in east-central Nevada (Figure 1). It is about 15 km from west to east throughout most of its 155 km north to south length. The Snake Range binds it on the west and by the Schell Creek Range to the east. From west to east, a sill to Steptoe Valley, the Antelope Range, a sill to Antelope Valley, and the Kern Mountains form its northern boundary. Lake Valley Summit, the Fortification Range, and the Limestone Hills separate the valley from Lake Valley to the southwest and Hamlin Valley to the southeast. It lies almost entirely within White Pine County, but its southern tip extends slightly into Lincoln County, Nevada.

Figure 1. Spring Valley, White Pine County, Nevada. Photograph by Dennis Ghiglieri.

Spring Valley is like most Nevada valleys in that it trends from north to south and is situated between two mountain ranges. Spring Valley distinguishes itself by its size and high elevation (minimum 1692 m [5550 ft] at Yelland Dry Lake). Moreover, the valley lies in the shadow of two of the highest mountains in Nevada, Wheeler Peak (3982 m [13,060 ft]) in the

Snake Range to the east (Figure 2), and North Schell Peak (3622 m [11,880 ft]) in the Schell Creek Range to the west. Spring Valley was never connected to either pluvial Lake Bonneville or pluvial Lake Lahontan, instead it was its own terminal basin throughout the Pleistocene Epoch, supporting its own pluvial lake during continental glaciations.

Spring Valley not only is larger, higher, and surrounded by higher mountains, it also distinguishes itself from other Nevada valleys in that it is well-watered; this in spite of the lack of a river in the valley (Figure 3). At least 105 springs flow in Spring Valley, as mapped by the USGS (88 on Ely, 11 on Kern, and 6 on Garrison 1:100,000 topographic maps), and it is because of these springs that the valley has its name (Simpson 1876, Carlson 1974).

Figure 2. Wheeler Peak during a fall storm in the Snake Range, overlooking "The Cedars" stand of Rocky Mountain juniper (*Juniperus scopulorum*) in Spring Valley, White Pine County, Nevada. Photograph by the author.

Figure 3. Wet meadow, Spring Valley, White Pine County, Nevada. Photograph by Dennis Ghiglieri.

Description of Ecosystems

The vegetation of Spring Valley is varied, with many different species dominant at different locations, due primarily to soil characteristics and water availability. At the very bottom of the valley, at Yelland Dry Lake, is a playa- a featureless, plant-free zone with saline soils comprised of fine silt and clay. Salinity declines moving away from the playa, corresponding with time spent under the pluvial lake. The general trend is that as elevation increases, salinity decreases.

The vegetation communities in the lowest elevations of the lake are halophytic facultative phreatophytes. That is, these plants can tolerate salt, and can draw on deep groundwater. The dominant shrub is these lowest vegetated areas of the valley is greasewood (*Sarcobatus vermiculatus*) (Figure 4). This is a tall shrub (up to 3 m), that is frequently accompanied by other tall phreatophytic halophytes such as four-wing saltbush (*Atriplex canescens*), and smaller, shallow-rooted halophytes such as shadscale (*Atriplex confertifolia*). Greasewood provides valuable winter forage for wildlife and livestock (Pratt et al. 2004). Grasses also occur in these shrublands, including valuable species such as Great Basin wildrye (*Leymus cinereus*) and saltgrass (*Distichlis spicata*) (Figure 5). Both species are important forage for wildlife and livestock and is common in greasewood shrublands, and saltgrass forms the drier edges of meadows near springs (Figure 6).

Figure 4. Greasewood (*Sarcobatus vermiculatus*) tall shrubland with green rabbitbrush (*Chrysothamnus viscidiflorus*) in Spring Valley, Nevada. Photograph by the author.

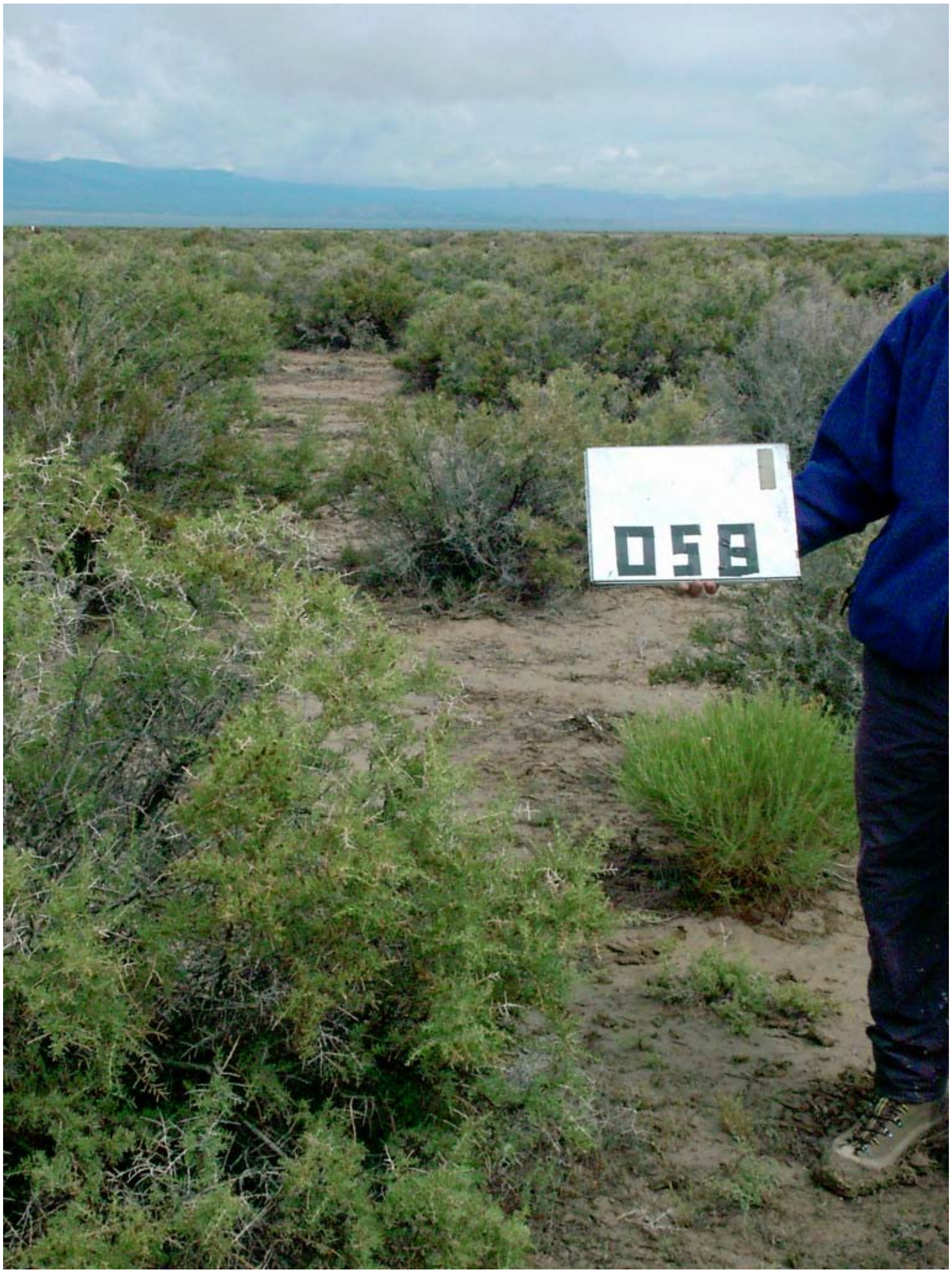


Figure 5. Greasewood (*Sarcobatus vermiculatus*) short shrubland with saltgrass (*Distichlis spicata*) understory. Photograph by Rob Klotz.

Figure 6. Saltgrass (*Distichlis spicata*) meadow in greasewood (*Sarcobatus vermiculatus*) shrubland in Spring Valley, Nevada. Photograph by the author.

Within the greasewood formation, small sand dunes are present in the west-central portion of Spring Valley near Baking Powder Flat, about 3 km west-southwest of “The Cedars.” These dunes are the result of the liberation of more mobile soil particles from the non-vegetated areas of the valley that deposit themselves and accumulate in this location due to the prevailing winds. Also within the greasewood formation is a surprisingly large amount of big Great Basin sagebrush (*Artemisia tridentata* ssp. *tridentata*). While big Great Basin sagebrush is common in every county of Nevada, it is unusual to share dominance with greasewood. These *Sarcobatus-Artemisia tridentata –Chrysothamnus* tall shrublands are widespread in the moderate elevations in the valley (Figure 7).

Figure 7. Mixed shrublands of Big Great Basin sagebrush (*Artemisia tridentata* ssp. *tridentata*), green rabbitbrush (*Chrysothamnus viscidiflorus*) and greasewood (*Sarcobatus vermiculatus*) in Spring Valley, Nevada. Photograph by the author.

Figure 8. Black sagebrush (*Artemisia nova*) shrublands in Spring Valley, White Pine County, Nevada. Photograph by the author.

Other kinds of shrublands dominate above the lowest elevations of Spring Valley. On the western piedmont slopes above the valley floor, winterfat (*Krascheninnikovia lanata*) shrublands are abundant. As its common name implies, this is critical winter forage for wildlife and livestock. Indian ricegrass (*Achnatherum hymenoides*) is the dominant grass in these communities, and also is valuable forage. Black sagebrush (*Artemisia nova*) is dominant in areas of hardpan (Figure 8). Black sagebrush is a short-rooted *Artemisia*, usually occurring in areas with hardpan or caliche 2 feet or less beneath the soil surface. Terpenes of black sagebrush, like all other *Artemisia* species, are toxic to the microfauna of ruminants such as pronghorn, deer, cattle, and sheep (Young and Sparks 1985). Big Great Basin sagebrush (*Artemisia tridentata* ssp. *tridentata*) is dominant in deeper soils along spring-fed streams in Spring Valley.

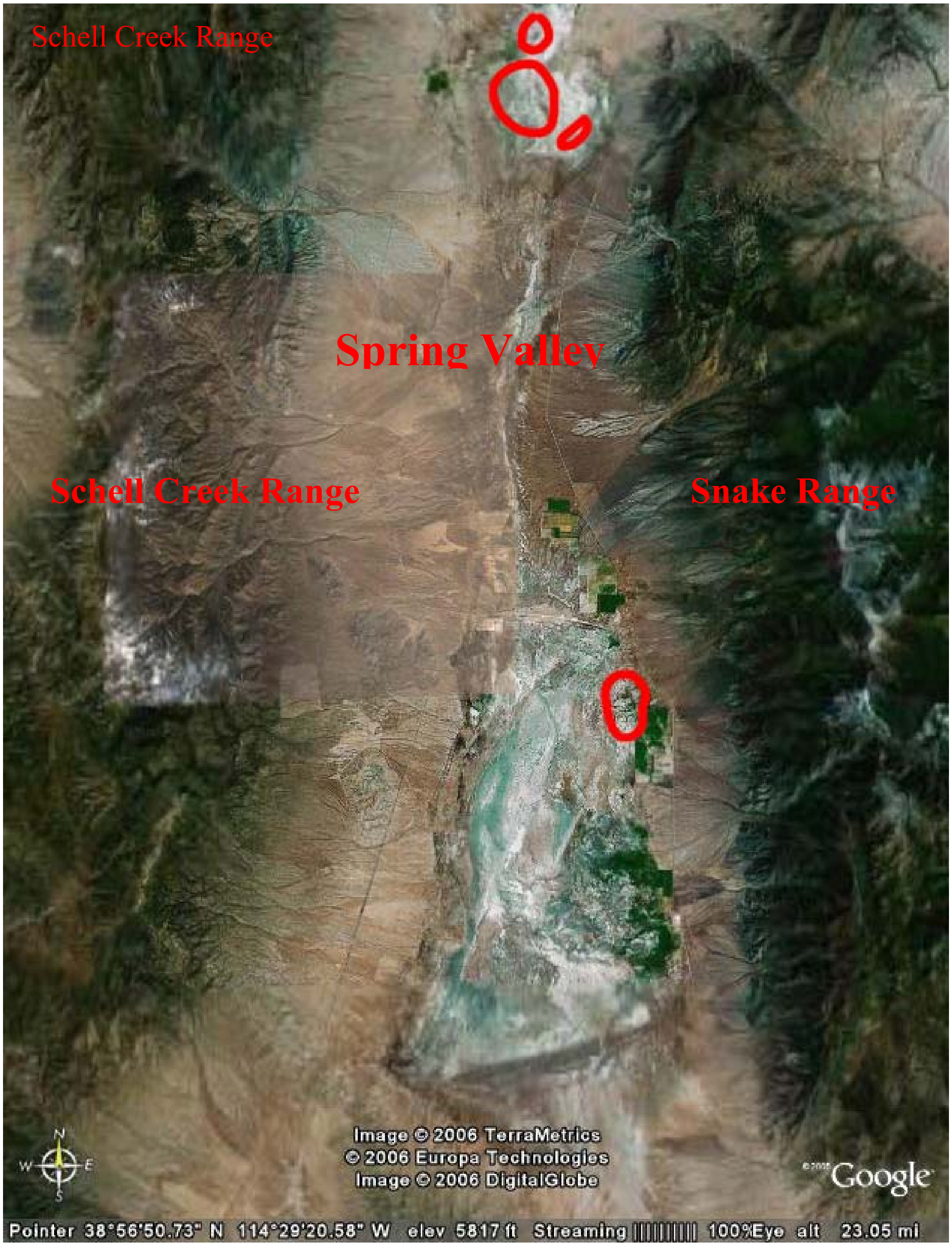
The "Swamp Cedars": A Unique Vegetative Feature

A vegetative feature that makes Spring Valley globally unique is the "swamp cedars" (Figure 9). The "Swamp Cedars" are a rare occurrence of a juniper species usually referred to as Rocky Mountain juniper (Figure 10). Rocky Mountain juniper (*Juniperus scopulorum*) is generally restricted to mountains, in Nevada up to 9300 ft elevation (Charlet, unpublished data, *VB Bostick 5867* @ UNLV). The exception in Nevada to this occurs as two populations of the species in Spring Valley (Figure 11).

Figure 9. "Swamp Cedars" (*Juniperus scopulorum*) and associated pond, wetland and meadow in Spring Valley, White Pine County, Nevada. Photograph by Dennis Ghiglieri.

Figure 10. Rocky Mountain juniper (*Juniperus scopulorum*), or "Swamp Cedar," in Spring Valley, White Pine County, Nevada. Photograph by Dennis Ghiglieri.

Figure 11. Location of *Juniperus scopulorum* stands (within red polygons) in the southern Spring Valley, Nevada. Snake Range to the east, Schell Creek Range to the west. Sacramento Pass is at the upper right portion of the figure.



History of Scientific Research on Swamp Cedars

Simpson (1876) was the first to report the existence of Spring Valley's swamp cedars, but they remained uncollected until Margaret Williams made the first collection in 1951. Her colleague, Dwight Billings, initially did not report their occurrence (Billings 1945), but reported them in the literature for the first time in a later edition (Billings 1954a) where Billings suggested they might represent a unique ecotype (Billings 1954b). Holmgren (1972, p. 130), Lanner (1984, page 118), and Kartesz (1988, page 46) all restated Billings' (1954b) point, but added nothing new. No mention of these stands was made in the *Juniperus* treatment in the Flora of North America (Adams 1993). Terry et al. (2000) undertook a regional study of *Juniperus* genetics throughout the Great Basin, but unfortunately they did not sample *Juniperus scopulorum*, and so the genetics of these populations remain unknown. The last reference to these in the literature is my own (Charlet 1996, page 115), but here I also simply restate Billings' (1954b) point and added nothing new except a list of 10 collections made from the site that are in herbaria. And so in the last 52 yr, there have been only 5 references to these stands, each suggesting their possible status as a unique ecotype, but nothing more has been done to study them. The swamp cedars of Spring Valley, Nevada have been neglected and unstudied. If they are a unique ecotype, that means that these populations have been deviating from other populations of Rocky Mountain juniper in common circumstances. Genetically isolated as the swamp cedars of Spring Valley are, they are well on their way to becoming a new species. As such, they may contain unique alleles (gene forms) that could be used to promote salt tolerance in conifers, or that may code for enzymes that produce novel compounds of medical importance.

"Swamp Cedars" of Spring Valley: Location and Description of Communty

The southern population of "swamp cedars" occurs between 1755-1790 m (5755-5870 ft) elevation, is about 1.75 mile from north to south, 1 mile from east to west; and occupies about 1.5 sq miles. It occurs in the south-central portion of the valley about 4 miles east of North Spring Point, at a location named "The Cedars" (as indicated on the USGS 1:100,000 scale topographic map "Garrison") (Figure 12). The northern population is located north and northeast of South Bastian Spring (SW of Sacramento Pass), from 1720-1730 m (5640-5675 ft) elevation (USGS 1:100,000 scale topographic map "Ely")(Figure 13). The main block of this population is about 2 miles from north to south and 1.75 mile from east to west. It occupies about 2 sq miles in the main stand, with ancillary stands amounting to about another 0.5 sq mile, for a total of 2.5 sq miles for the northern population. In all, the swamp cedars dominate about 4.0 sq miles habitat in Spring Valley, Nevada. These stands are separated by about 20 km (Figure 10).

The swamp cedars form parklands, woodlands, and thickets within a shrubland matrix of various mixtures of greasewood (*Sarcobatus vermiculatus*), green rabbitbrush (*Chrysothamnus viscidiflorus*), rabbitbrush (*Chrysothamnus nauseosus* and *Chrysothamnus viscidiflorus*), shadscale (*Atriplex confertifolia*), and Great Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Native grasses associated with these woodlands include Great Basin wildrye (*Elymus cinereus*), saltgrass (*Distichlis spicata*), and alkali cordgrass (*Spartina gracilis*). Areas around springs support Baltic rush (*Juncus balticus*) and bulrush (*Scirpus* sp.).

Figure 12. Digital Orthophotoquad with soil type polygons (NRCS 2006) of "The Cedars" in southern Spring Valley, White Pine County, Nevada.

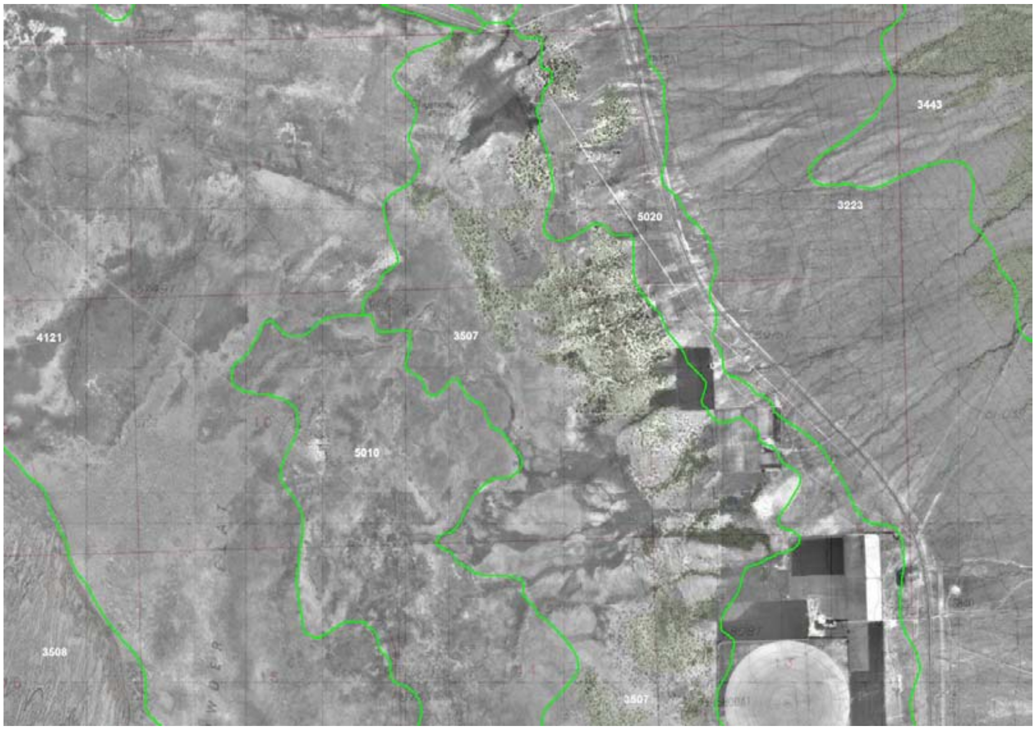
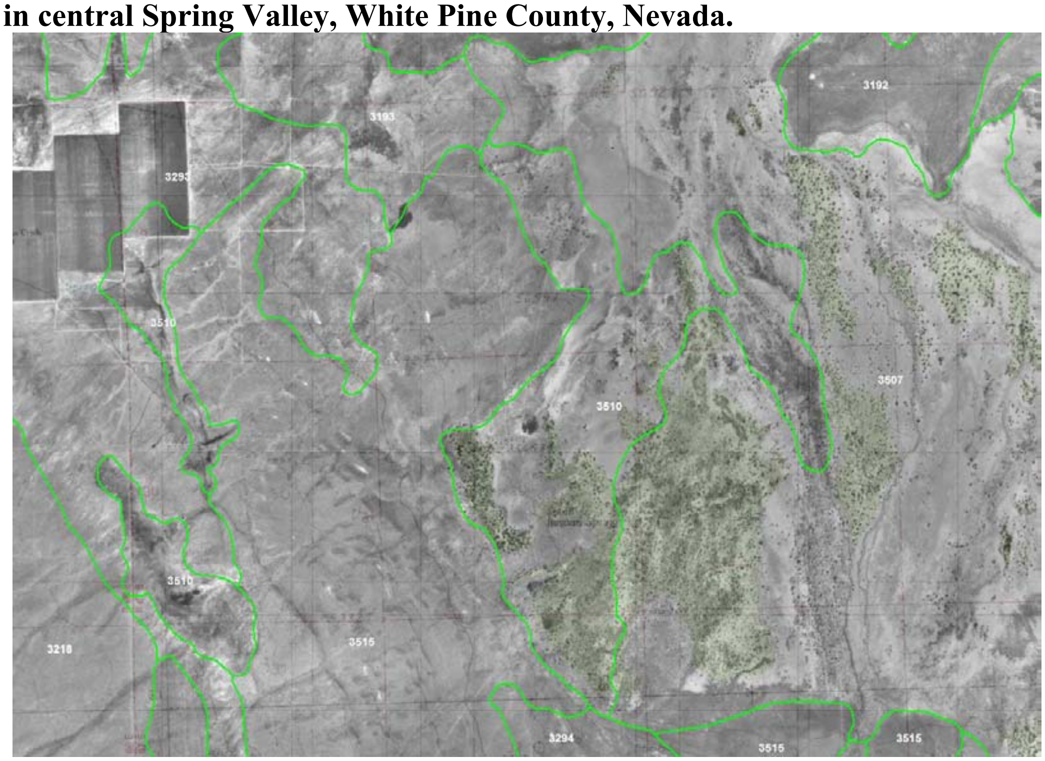


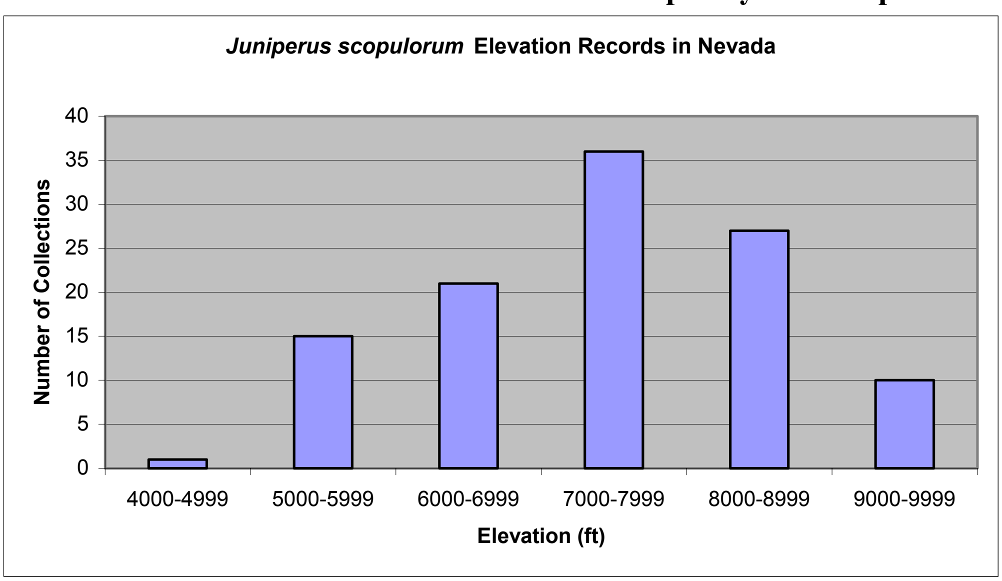
Figure 13. Digital Orthophotoquad with soil type polygons (NRCS 2006) of South Bastian Spring in central Spring Valley, White Pine County, Nevada.



Both swamp cedar populations possess saline soils of the Ewelac and Biji Series (NRCS 2006). This is so because salts concentrate there after the pluvial lake that appears during glaciations evaporates during interglacials, such as now. The stands occur just above the lowest points in the valley, these lowest elevations rendered into saline flats (playas) void of vegetation due to excessively high salt content and occasional seasonal flooding. At the swamp cedar stands, springs emerge, providing essential water for the populations to survive the valley's high summer temperatures.

The swamp cedar stands are fascinating for several reasons. First, they are the only native arboreal feature in the valley, providing valuable structural complexity for native wildlife otherwise unknown in the valley. Second, the nearest collection of *Juniperus scopulorum* to the swamp cedars is 17 km away, in the Snake Range at the confluence of Strawberry Creek and Blue Canyon at 8030 ft elevation (*Charlet 2797 @ UNLV*). Moreover, in Nevada there are 5 species of juniper and as of Charlet (1996), there were 842 known collections in Nevada of these five juniper species. Of these Nevada juniper collections, only 14 collections were made in valleys, 12 of these the swamp cedars of Spring Valley. In fact, any conifer dominating even portions of valley floors violate the general repeating scheme of vegetation zonation proposed for the Great Basin by Billings (1951). Of the 110 collections of *Juniperus scopulorum*, only 4 collections other than the Spring Valley swamp cedars were made below 6000 feet elevation, these all in deep canyons with perennial streams (Figure14). Third, in North America, there are only three other locations where any juniper is dominant in a temporarily flooded situation, these other occurrences are rare and appear in Montana, Colorado, and Idaho (NatureServe 2006). However, none of the associated species are the same, nor is the water table saline, and so the Nevada populations are unique. Finally, as Ron Lanner (2006) points out in his report, no other juniper species in the world occurs in situations such as these, so these populations are globally unique.

Figure 14. *Juniperus scopulorum* elevation in Nevada as recorded on museum collections in 19 herbaria (*n* = 110; see Appendix 1 for herbarium list). Note that a total of 16 collections have been made below 6000 ft, with 12 of these in Spring Valley, Nevada. The other four low elevation collection records were made in deep canyons with perennial streams.



The junipers are probably there because they were forced down to the valley out of the mountains during one (or more) of the glacial events of the Pleistocene Epoch (Charlet 2006a). Here they were stranded during the interglacial, but because of the springs and associated high water table, resident populations were able to sustain themselves at the site. Curiously, the greater tolerance to cold of *Juniperus scopulorum* compared to *J. osteosperma* probably also assists the persistence of these stands, as *J. osteosperma* occurs on both sides of the valleys in the foothills and upper piedmont slopes of both the Schell Creek and Snake Ranges, but these do not descend into the valley bottom as does the *J. scopulorum*. This is likely due to cold air drainage during the winter causing excessively low temperatures that prevent the necessary hardening off of *J. osteosperma* seedlings (Billings 1954a), while the *J. scopulorum* are tolerant enough of the cold to harden off before the deep winter cold.

The Rare Parish Phacelia

Another rare occurrence is Spring Valley is Parish Phacelia (*Phacelia parishii*). *Phacelia parishii* is locally abundant either by itself or with *Phacelia fremontii* in open spaces between *Atriplex* shrubs on the margins of dry lakebeds. The species sprouts once the ephemeral waters of the lake evaporate and the playa mud begin to dry and separate in mid-spring (Figure 15). *Phacelia parishii* populations are naturally isolated from one another given their dependence on dry lakebeds. The playas in which it occurs are necessarily separated from one another. Weak connections exist between the playas via low passes between mountains. Dispersal between valleys, and subsequent gene flow between individuals in these locales, probably depends on occasional long-distance wind dispersal of its small seeds. Parish phacelia is covered in the Clark County MSHCP and ranked as a C2 species (potentially a candidate for listing under the Endangered Species Act) by the Nevada Natural Heritage Program. *Phacelia parishii* was included on Nevada's watch list by Mozingo and Williams (1980). Conservation Status reports for *Phacelia parishii* were prepared for its range in California (Constance 1979), and the Nevada Test Site (Blomquist et al. 1995). Smith (1996) prepared a comprehensive report for the species throughout its distribution, with particular focus on its Nevada populations (Smith 1996). The Nevada Natural Heritage Program has the species on its watch list, and has a fact sheet and general map available to the public (Morefield 2001). The global conservation rank for *Phacelia parishii* is G2G3, and its state rankings are S1 in Arizona, S1.1 in California, and S2S3 in Nevada. It is therefore globally imperiled, and critically imperiled in Arizona and California. However, *Phacelia parishii* is not threatened, endangered, or a candidate for listing under the ESA. Similarly, the species has no protection from the State of Nevada (Morefield 2001).

The species is nearly endemic to Nevada, with only two locations known outside the state, one small population in California and another small one in Arizona. It is known historically from Stewart Valley (Nye County), White River Valley (Nye County), Lake Valley (Lincoln County), Las Vegas Valley (Clark County), Three Lakes Valley (Nye County), Indian Springs Valley (Nye and Clark Counties), and at four locations in Spring Valley. *Phacelia parishii* was last observed in the Las Vegas Valley in 1979 and is almost certainly extirpated from the valley. Its status in Indian Springs and Three Lakes Valleys (in the NRC) is uncertain (Frank Smith, personal communication 2004). That leaves only the Stewart Valley, White River Valley, Lake Valley, and Spring Valley populations that are more or less secure at this time.

Figure 15. *Phacelia parishii*, blooming in the drying playa mud of Stewart Valley, Nye County, Nevada. Photograph by the author.

The species requires either spring discharge or winter to early spring precipitation in sufficient quantities to form ephemeral lakes in the playas where it occurs. Exactly how much water is needed is unknown. *Phacelia parishii* has a tiny, tubular flower that is insect-pollinated, almost certainly a solitary bee that nests in the clays of the playa where the larvae develop and pupate during the non-growing season (Rich Rust, University of Nevada Biology Professor, personal communication 2004).

Wildlife

The complexity and diversity of the entire suite of vegetation communities in Spring Valley provides valuable cover and forage for pronghorn (Tanner et al. 2003) (Figure 16). T anner et al. (2003) specifically mention the swamp cedar stands as being used by pronghorn. In addition to pronghorn, Mule deer (*Odocoileus hemionus*) use Spring Valley for winter range.

Figure 16. Pronghorn (*Antilocarpa americana*) in temporarily flooded greasewood (*Sarcobatus vermiculatus*) shrubland at the Malheur National Wildlife Refuge, Oregon, May 2003. Photograph by Phil Myers, Museum of Zoology, University of Michigan and downloaded from Animal Diversity Web, Museum of Zoology, University of Michigan.

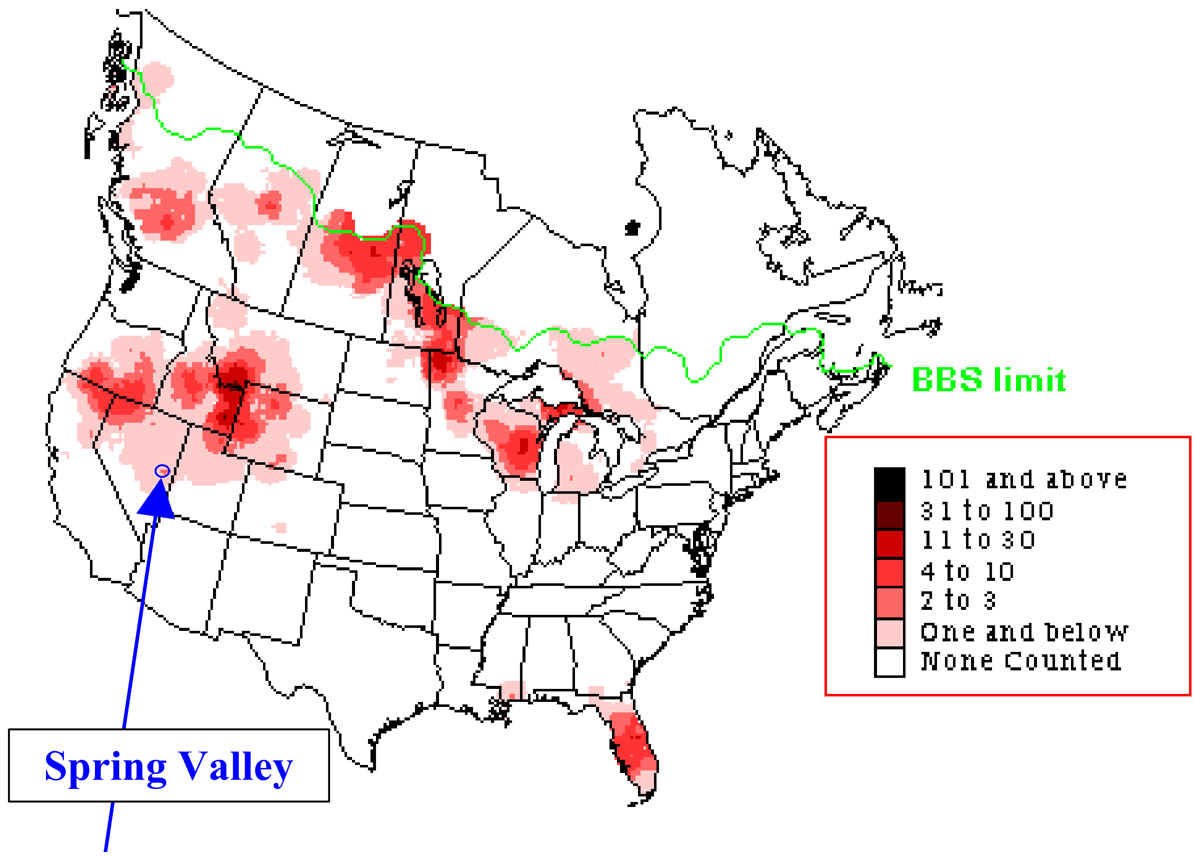
The wetlands, springs and ponds in Spring Valley also provide valuable habitat for migratory and resident birds (Brussard et al. 1999). In 2003, I observed a Sandhill Crane (*Grus canadensis*) near Blind Spring, in the southern Spring Valley. Sandhill Cranes are mapped has having at least 2 breeding pairs in Spring Valley by the USGS (USGS 2006), the most southerly location west of the Mississippi aside from a single pair known from southern Colorado (Figure 17).

Current Status of the Spring Valley Ecosystems

Ecosystems of Spring Valley, like most valleys in Nevada, are stressed (Brussard et al. 1999). Overgrazing, particularly during the late 1800s (Young and Sparks 1985, Charlet 2006b), water diversions, and groundwater pumping have weakened the plant communities. The weakened state makes them susceptible to invasion by alien invasive weeds, especially cheatgrass (*Bromus tectorum*) in neutral soils and halogeton (*Halogeton glomeratus*) in more saline soils.

Existing water diversions have no doubt stressed the native plant communities of Spring Valley. Aqueducts divert Shingle Creek and the creek issuing from Williams Canyon, above the South Bastian Spring and "The Cedars" swamp cedar stands, respectively, and so reduce the amount of water they would otherwise receive. In spite of the stress they are under, the ecosystems of Spring Valley are in better condition than most Nevada valleys.

Figure 17. Distribution of breeding pairs of Sandhill Cranes (*Grus canadensis*) in the United States and Canada. Note that Spring Valley is the most southern location west of the Mississippi of at least two breeding pairs. Data and map from USGS (2006).



Effects of Proposed Action on the Spring Valley Ecosystems

The groundwater development proposed by the SNWA for the Spring Valley will doom the populations of swamp cedars. It is unlikely that they will live long past the first 20 yr of drawdown, as their locations are in the immediate vicinity of the main portion of the proposed wells, and drawdown is predicted by Myers (2006) to be most dramatic in the regions of the junipers (Figure 18).

The proposed interbasin water transfer may affect the Spring Valley populations of *Phacelia parishii* insofar as they will reduce surface water flow from spring discharge, and so not moisten as much of the playa margins as is presently the case. This action will not only affect the Spring Valley population, but may impact the possibly hydrographically connected Lake Valley population, these sustained by seasonal flooding of the playa in Lake Valley. If so, this leaves only the White River population, sustained by seasonal flooding of the White River, and the Stewart Valley populations without imminent threats on their event horizons. Moreover, the proposed action may have negative effects on the populations of the unknown pollinator of *Phacelia parishii*. It is necessary for the females of the pollinator species (probably a groundnesting, solitary bee) to have wet mud in order to build their nests (Richard Rust, Professor of Biology, University of Nevada personal communication 2004).

The general trend of the ecosystems during the proposed action will be to simplify the vertical structure of the vegetation, reduce the biodiversity of the communities, transform wetlands into xeric sites, and dramatically reduce the amount of palatable forage in the valley.

Predicted Successional Series During 1000 years of Pumping

The swamp cedars will be the first plant species in the valley to become locally extinct, and I imagine that they would not be able to hang on for more than 50 yr. The next species to follow the swamp cedars will be the greasewood (*Sarcobatus vermiculatus*), followed shortly by big Great Basin sagebrush (*Artemisia tridentata* ssp. *tridentata*), and finally by rabbitbrush (*Chrysothamnus* spp.).

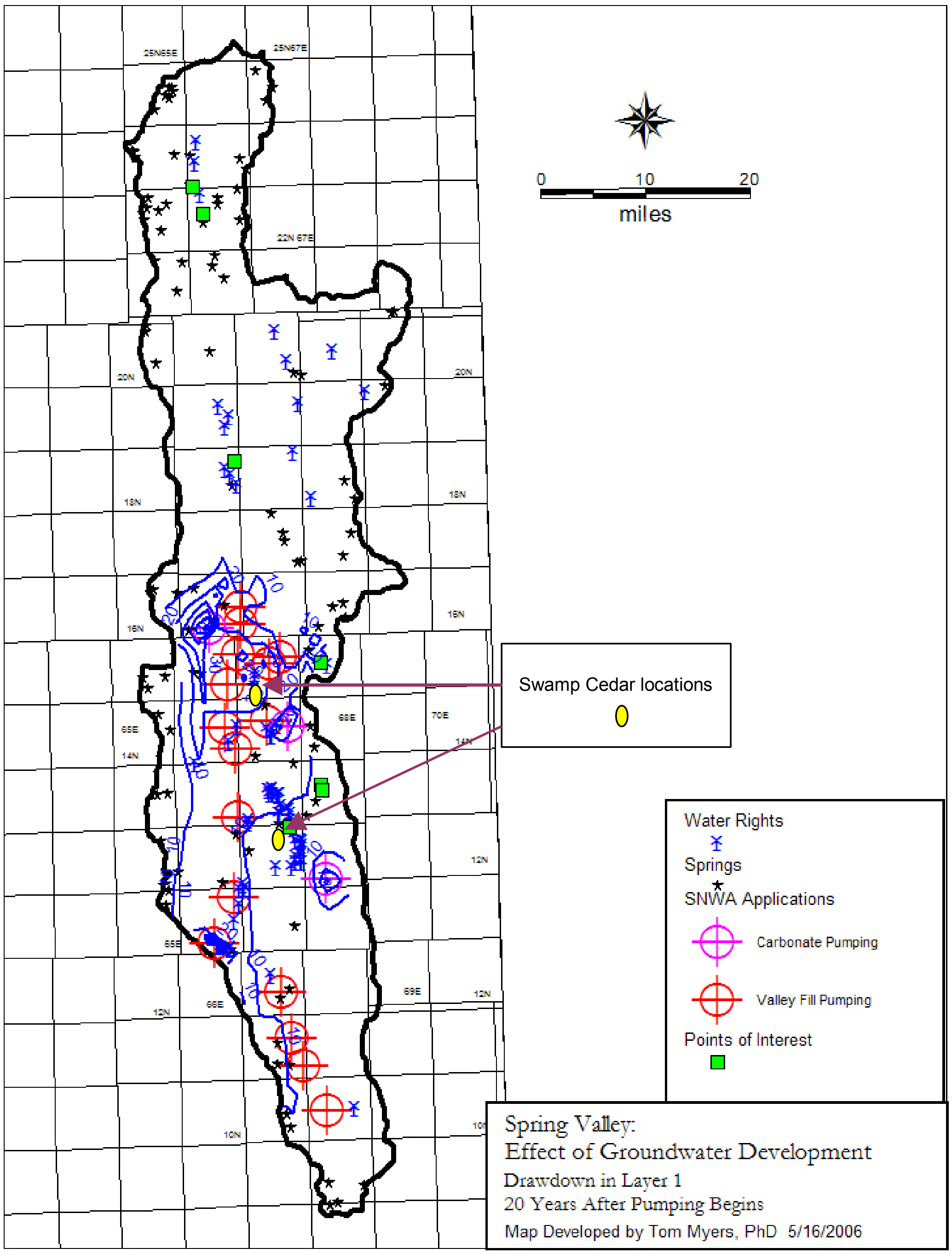
The successional series of communities that will replace them will likely be the following. Big Great Basin sagebrush shrublands will be invaded by cheatgrass and, in the absence of fire, can ultimately be replaced by black sagebrush (Artemisia nova) shrublands. Should there be fire events during this transition, the community can easily become a pure stand of cheatgrass.

The greasewood and winterfat shrublands will also be invaded by cheatgrass, and potentially could be converted to shadscale shrublands. An additional factor here that could come into play is the alien, saline-tolerant weed halogeton which will increase in these shrublands. A danger in this is a massive and inexplicable die-off in winterfat with the increase in halogeton, something that has been observed at the USDA Forest Service Desert Experimental Range Station in Pine Valley, Utah (Stan Kitchen, Desert Experimental Range Station Director, 2006, personal communication).

There is also danger of desertification in the area of Baking Powder Flat. Here, where sand particles from devegetated areas naturally accumulate into sand dunes, the sand dunes could grow and become more mobile, rendering shrublands into sand dunes.

The pioneering replacement species at the swamp cedars' location and neighboring areas dominated by greasewood will most likely be the salt-tolerant, non-native, invasive and poisonous weed *Halogeton glomeratus*. Hopefully, the native shrub shadscale (*Atriplex confertifolia*) will ultimately dominate the area, representing a greatly simplified and far less valuable rangeland with poor wildlife value compared to greasewood shrublands and juniper woodlands, but far better than the *Halogeton* alternative.

Figure 18. Location of Swamp Cedars in Spring Valley overlain on Myers (2006: Fig. 24), indicating the drawdown in layer 1 after 20 years of pumping. Note that in both swamp cedar locations, drawdown of about 10 feet has occurred, effectively dooming both populations.



The building of the pipeline through the valley will provide establishment opportunities and migration corridors for the already resident alien weeds, and connecting this valley to more southerly valleys will provide a new corridor of migration for another alien brome wreaking havoc with ecosystems in the Mojave Desert, red brome (*Bromus madritensis*), further destabilizing the ecosystems of Spring Valley. The one-time disturbance of building a pipeline in the desert takes from 100-300 years for the reestablishment of the dominant woody vegetation (Lathrop and Archbold 1980).

Simplification of vegetation structure is devastating to semi-arid ecosystems and has occurred in similar systems in Iran (Charlet 2006b). A similar situation occurred in Owens Valley, California, after the Los Angeles Department of Water and Power drained the sources of the Owens River. In 1930, after the Los Angeles Aqueduct was only operating for 17 years, Owens Lake was dry. Now the Los Angeles Department of Water and Power is irrigating the lake in a $451 million project designed to reduce the toxic particulates that the lake has been releasing in the past 70 years (Biland and Fasano 2006). I anticipate the consequences to wildlife that inhabit Spring Valley will be severe and similar to those seen in Owens Valley. The diverse combination of multi-layered shrubland and woodland structure (provided by the swamp cedars) magnifies the wildlife value of these ecosystems, especially to the pronghorn.

Figure 19. Owens Lake dust storm. Photograph by David Maisel, courtesy U.S. Environmental Protection Agency.

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Appendix 1. Herbaria where Charlet examined and catalogued all Nevada conifer collections (Charlet 1996, and Charlet, work in progress).

ACRONYM	INSTITUTION NAME	LOCATION
AUSTIN	USDA Forest Service Austin Ranger District Herbarium	Austin, NV
BRY	Brigham Young University Herbarium	Provo, UT
CAS	California Academy of Sciences	San Francisco, CA
DUKE	Duke University	Durham, NC
IFGP	Institute of Forest Genetics	Placerville, CA
RMRSR	USDA Forest Service Rocky Mountain Research Station	Reno, NV
NSM	Nevada State Museum	Carson City, NV
NY	New York Botanical Garden	New York, NY
OGDF	USDA Forest Service Ogden	Ogden, UT
OSC	Oregon State College	Ashland, OR
RENO	University of Nevada, Reno	Reno, NV
RSA	Rancho Santa Ana Botanic Garden	Claremont, CA
UC	University of California, Berkeley	Berkeley, CA
UCR	University of California, Riverside	Riverside, CA
UNLV	University of Nevada, Las Vegas	Las Vegas, NV
US	National Herbarium, Smithsonian Institute	Washington, DC
UT	University of Utah	Salt Lake City, UT
UTC	Utah State University	Logan, UT
UW	University of Washington	Seattle, WA

(Signed) David A. Charlet

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24 June 2006