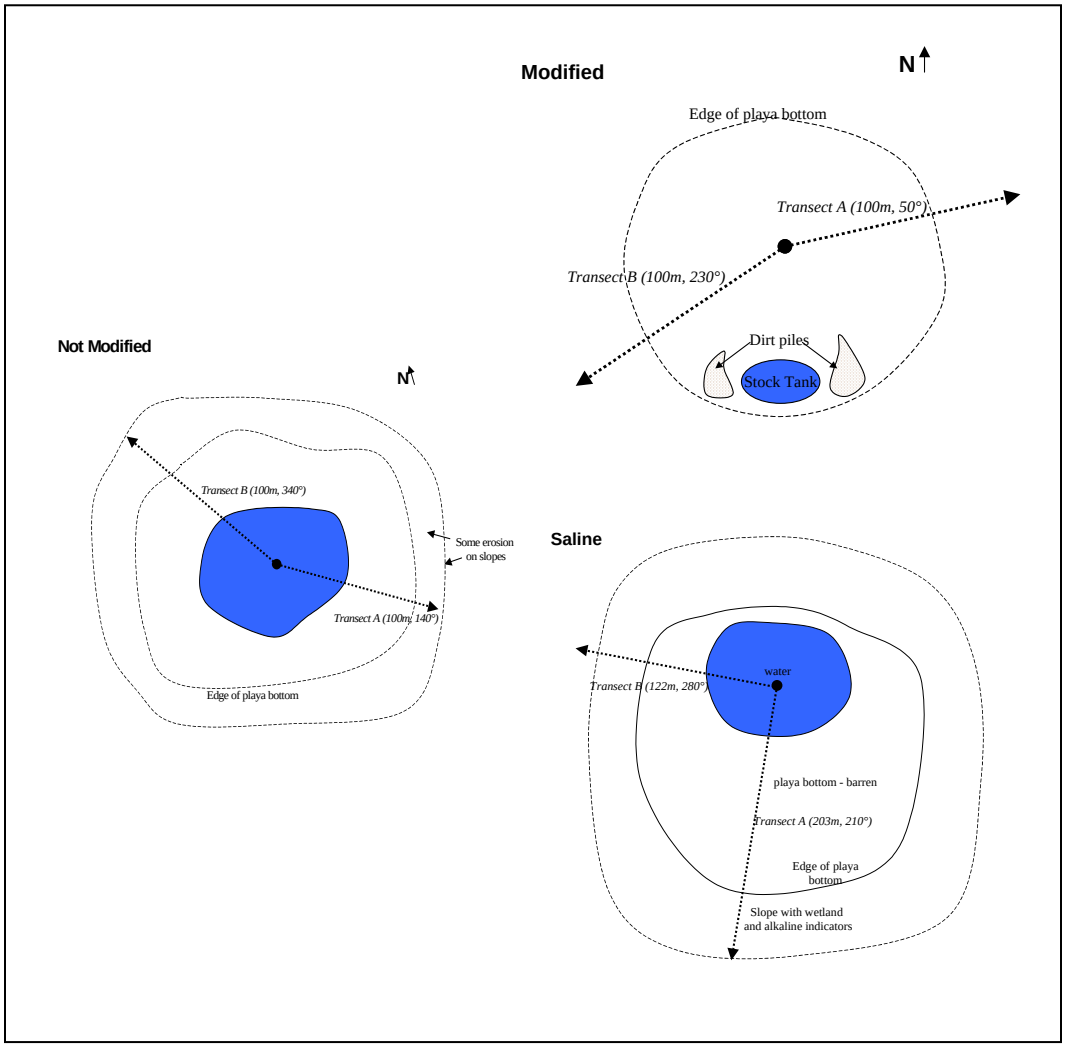
Playa Wetlands in Northeastern New Mexico

A Comparative Study of Vegetation Diversity and Ecology



The University of New Mexico

New Mexico Natural Heritage Program

Playa Wetlands in Northeast New Mexico
A Comparative Study of Vegetation Diversity and Ecology [1]

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May, 2000

SUMMARY

In the arid and semi-arid lands of New Mexico, playa basins dependent on seasonal precipitation are vitally important resources for wildlife (particularly migratory birds), livestock and humans. In many cases, they have been physically or chemically modified as a result of or to accommodate farming, ranching, or oil development activities. Playa modification can disrupt hydrological regimes, which in turn may affect water chemistry, species composition, and ecological function. To gain a better understanding of the ecology and biological status of these important resources, the New Mexico Natural Heritage Program (NMNHP) and the New Mexico Environment Department (NMED) Surface Water Quality Bureau conducted a comparative study of vegetation communities, water quality and invertebrates among relatively natural freshwater or saline playas and those that have been modified for ranching purposes in northeastern New Mexico rangeland during the fall of 1998. In particular, we looked at vegetation and soil zonation patterns within twelve selected playa basins.

We found concentrically arranged vegetation associations in natural playas progresses from a central zone of obligate or facultative wetland species to an intermediate zone dominated by facultative wetland and facultative species on the outer basin bottom to the driest zone on the basin brims dominated by upland species. Playas that have been modified are still concentrically zoned, but zones are less distinct and vegetation is more homogenous throughout the basin bottom. This homogenous vegetation is characterized by facultative species adapted to moderately dry conditions, such as western wheatgrass (*Pascopyrum smithii*) and poverty sumpweed (*Iva axillaris*), both of which are rhizomatous perennials. The perennial nature of the dominant flora suggests established hydrological conditions.

Saline playas sampled have a markedly different vegetation pattern. Basin bottoms are uniformly flat and devoid of vegetation, save for a few small patches of saltgrass (*Distichlis spicata*). Vegetation occurs primarily on the slopes and is composed of wetland species which are often halophytic wetland indicators, such as saltgrass, alkali sacataon (*Sporobolus airoides*) and seepweed (*Suaeda* spp.). This pattern indicates a longer time of inundation in past years wherein plants on the basin floor perish due to high salt content and/or anoxia, but thrive at the fringes where the water table is present but receding.

General drier conditions of playas within the study area are probably due to climatic and longitudinal factors in combination with hydromodification. Northeastern New Mexico is at the highest elevation and the furthest point west for the playa lake region, where precipitation is substantially less that received elsewhere in the High Plains. Hydromodification in this region, although widespread, is not impacting playas to the extent that has occurred in other regions, particularly where playas are used for polluted irrigation water runoff (in Texas and Kansas) or oil waste dumping (southeastern New Mexico). It should be possible to rehabilitate degraded playas for wildlife habitat while retaining their value for the landuser.

[1] Submitted the New Mexico Environment Department Surface Water Quality Bureau 1190 St. Francis Drive Santa Fe, NM 87502 in fulfillment Professional Services Contract No. 98-667-5000-0011

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INTRODUCTION

In the arid and semi-arid lands of New Mexico, the playa basins that fill seasonally with water are vitally important resources for wildlife (particularly migratory birds), livestock and humans. In many cases, they have been physically or chemically modified to accommodate farming, ranching, or oil development activities (Haukos 1992). Alteration of playas can disrupt hydrological regimes, which, in turn may affect water chemistry, species composition, and ecological function. Yet, studies on the biota and ecology of these ecosystems in New Mexico is limited. Of an estimated 2,460 playas in the state (Bolen *et al.* 1989), only six have been surveyed for vegetation and soils (Durkin *et al.* 1994), and only 26 have been surveyed for water quality and benthic invertebrates (Davis *et al.* 1992, 1994). To gain a better understanding of the ecology and biological status of these important resources, the New Mexico Natural Heritage Program (NMNHP) and the New Mexico Environment Department (NMED) Surface Water Quality Bureau conducted a comparative study of vegetation communities, water quality and invertebrates among relatively natural freshwater or saline playas and those that have been modified for ranching purposes.

In New Mexico, there are three major regions with an abundance of playas: the Great (High) Plains of the northeast, the Llano Estacado of the southeast, and the Chihuahuan Desert in south-central New Mexico. Although any of these regions could be studied for our purposes, we chose playas in northeastern New Mexico because it was the only area in New Mexico with moisture sufficient to allow for water sampling in 1998. These playas share similar geologic origins, plant composition, and morphology with the estimated 25,000 – 30,000 playa wetlands of the Southern High Plains that recharge the underlying Ogallala aquifer (Nativ 1992, Haukos and Smith 1994, Hoagland and Collins 1997).

Vegetation pattern in playas is greatly influenced by the soil moisture gradient that develops when water collected in the basin gradually moves towards the center, with some being lost to evaporation and some to infiltration. The soil moisture gradient, together with basin topography and various soil types, creates noticeable and measurable zones of vegetation (Bolen et al. 1989, Hoagland and Collins 1997). Any modification of playa morphology that affects hydrology and the soil moisture gradient should be reflected in the amount, type and zonation of perennial vegetation. Northeastern New Mexico is primarily rangeland, and playas are commonly excavated in the center or at one end to create a stock tank of deeper water. Thus, we compared vegetation and soil zonation patterns among excavated (modified) playas and non-modified playas, and present the results here in terms of plant species diversity and ecology in relation to soil characteristics[2].

[2] Water quality analysis and invertebrate survey results will be presented by the New Mexico Environment Department in a separate report.

MATERIALS AND METHODS

Study Area

Site selections

In September 1998, we conducted aerial reconnaissance over northeastern New Mexico, photographing and videotaping 81 playas which had been previously identified from topographic maps[3]. Of the 81 playas surveyed, only eleven appeared to have water in them, and some of these were rejected from consideration for reasons of access or landownership. Eventually, five modified and five non-modified playas were selected for sampling, and we also opportunistically sampled two saline playas.

Overall site description

The study area lies between 36º 05'00" to 36º 27'30" latitude and 103º 35'00" to 104º 37' 30" longitude within Mora, Harding and Colfax counties (Figure 1). The Candian River flows south here from its origin in Colorado, and forms the county line between Mora and Harding Counties. All sampled playas are on state trust or federally-owned land, and all but one are within a 70 mile radius east of the town of Springer; the exception being Playa #9, which is east of Mosquero (Figure 1).

The study area is part of the Raton Section of the Great Plains physiographic province (Hawley 1986) in Plains and Great Basin Grassland (Brown and Lowe 1978) typified by large expanses of gently rolling short-grass prairie sprinkled with numerous playa depressions. These plains were formed, in part, from Quarternary wind-formed deposits that originated from weathered gravel and sand washed off from the Sangré de Cristo Mountains to the west during the late Tertiary. Weathered shale alluvium dating from the Cretaceous era has also contributed to the formation of the relatively deep, loamy soils of the grassy plains (Chronic 1987). Young Tertiary basalt flows cap remnants of the High Plains surface and associated underlying alluvial deposits throughout the Raton Section and are seen as buttes and mesas (Hawley 1986). The Raton Section overlies Dakota sandstone, a porous formation which acts as an aquifer, collecting runoff water from the Sangré de Cristos and moving it east (Chronic 1987). The massive Ogallala Aquifer that underlies much of the Great Plains ends to the east and south just short of our study area (Environmental Protection Agency 1999). Most precipitation falls in the form of convective rainstorms between May and August, averaging between 35 and 40 cm annually, with considerable variation from year to year (Bennett 1986). All playas appeared to occur within similar loamy, rolling hill landscapes and have similar geologic origins, save the saline playas. Although alkalinity was not confirmed until water quality results were in, the two playas that we identified as saline in the field had distinctly different soils and vegetation patterns from the other playas.

[3] Plane and aerial photography contributed by Ted Cline of Photair, Inc., Arcadia MI

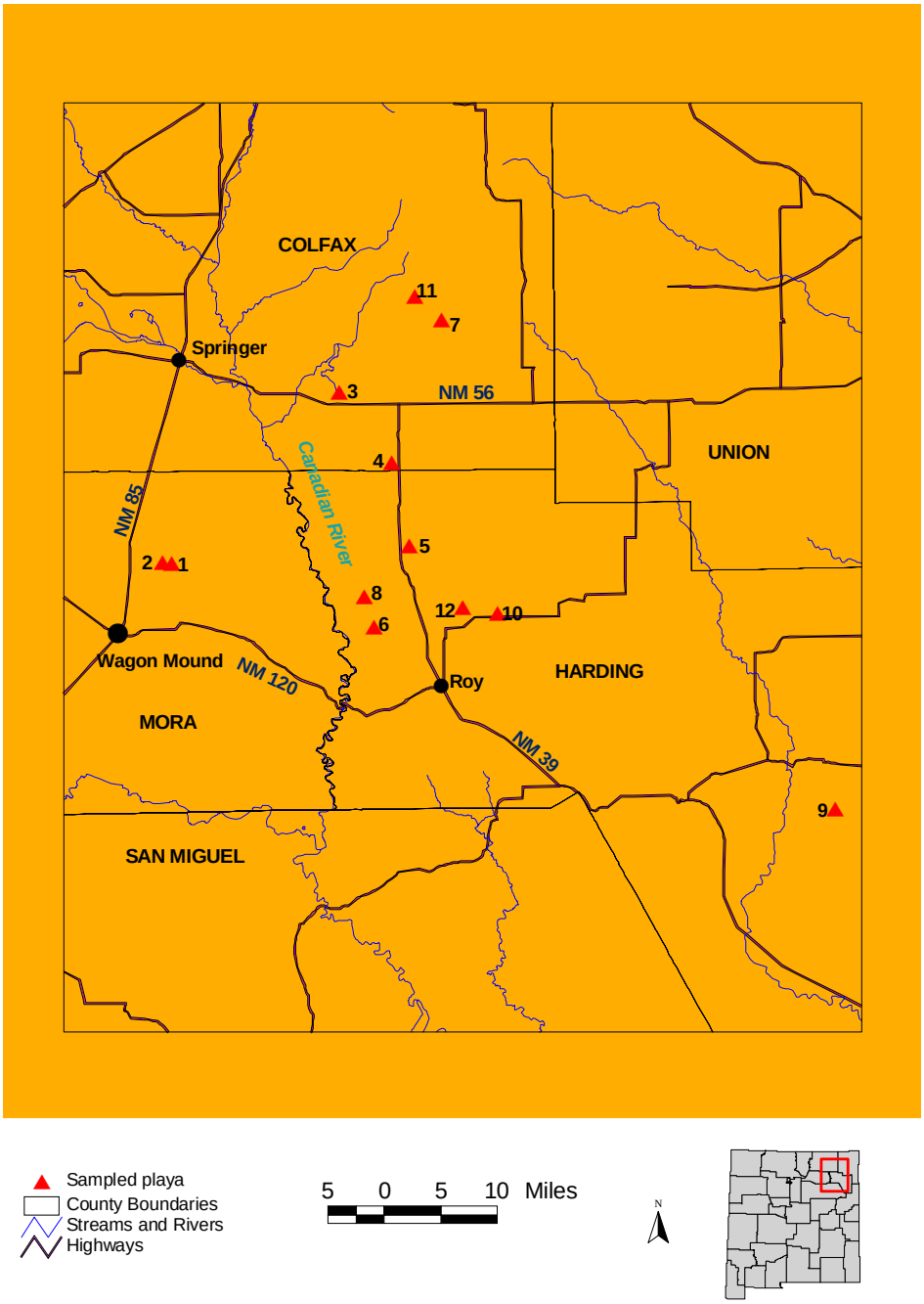


Figure 1. Map of study area

There have been many hypotheses on playa origin, formation and maintenance. Recently, Gustavson *et al.* (1994) reviewed existing hypotheses and presented new data to develop an explanation that includes pedogenic, geomorphic, hydrochemical and biologic processes. They postulate that playa basins most likely originated in small, irregular depressions that had resulted variously from surface drainage, subsidence caused by salt dissolution, differential compaction, animal wallows, or blowouts. Runoff collected in these basins killed or inhibited vegetation, allowing deflation to remove some of the surface sediment when the pond dried out, thus deepening the basin. Playa circumference was enlarged through centripetal drainage that eroded the basin margin and carried sediment to the basin floor. Periodic flooding continued to keep the center of the playa basin relatively clear of vegetation, which favored further deflation during dry periods. Deflation may have been accelerated by large herds of bison pulverizing the dried surface soils and carrying small amounts of sediment out of the basin on their hooves. Fine sediments, including silt and fine sand-sized material, that originate from basin deflation are carried downwind and incorporated into loess, that is later deposited during runoff as lacustrine sediments. There is evidence that this cyclic process of wind deflation followed by runoff sedimentation is active today in many playas.

Sampling Methods

Field work was conducted between September 29, 1998 and October 21, 1998. At that time, many of the playas did not have enough water in them to perform an adequate water quality assessment, and complete water quality sampling did not occur until May 1999, following some stunning rainstorms. Playas were assigned numbers, generally coinciding with the order in which they were sampled (Figure 1). Some playas have map names, and these were also used in designations.

At each playa, two belt transects were established extending from the center of the playa basin to just beyond the transition to upland vegetation (blue grama and buffalo grass) on the slopes. Transect direction was determined by randomly picking azimuth points between 0º and 360º with the caveat that points should be at least 45º apart. At playas with deep water that precluded sampling from the center of the playa, such as #3, sampling lines were projected towards the center, but begun in a water depth of 1m or less. Figures 3, 4, and 5 contain diagrams of each playa and transect lines and distances.

Plant cover was measured continuously along the transects using quadrats measuring 50 cm x 20 cm in dimension placed lengthwise along the line. Within the quadrat, canopy cover[4] of each species was estimated to the nearest percent for species with over 1% cover. Species with cover under 1% were estimated to the nearest 10th percent. Rock, bare soil, litter, and water cover types were also estimated, so that 100% of the cover in each quadrat was accounted for. Marks printed on the quadrat frame every 10cm help to ensure reasonable accuracy of cover estimates. Voucher specimens were made of most plants in the playa.

[4] Defined as the vertical projection of vegetation covering the ground above the ground surface

Along the line of each transect, we surveyed the playa basin using a transit level and stadia rod. The stadia rod measures elevation relative to the transit level to the nearest inch. The stadia rod was placed at points of obvious vegetation or at topographical breaks. In most instances, the cross section extended into the uplands for a longer distance than the vegetation transect.

Surface soil information was collected along one transect in each playa in obviously different zones of vegetation and/or surface soil texture. An augur, 20 cm long and 7 cm wide, was used to core down to saturated soils, usually a depth of about 40cm. Heavy clay often necessitated using a shovel in place of the augur. For each sample, texture, color, percent clay, percent roots, percent gravel, and presence of mottles were recorded.

All data were entered into a Microsoft Access database designed specifically for this project. Data tables previously developed by the New Mexico Natural Heritage Program augmented the database.

Voucher specimens were keyed out, and all species names and common names follow the nomenclature of Kartesz (1994). Plant species were categorized into the wetland categories listed in the National List of Plant Species that Occur in Wetlands (Reed 1997). These are:

1) *Obligate wetland plants* (OBL) - Occur almost always (>99%) under natural conditions in wetlands,
2) *Facultative wetland plants* (FACW) – Usually occur in wetlands (67-99%), but occasionally found in non-wetlands.
3) *Facultative plants* (FAC) – Equally likely to occur in wetlands or non-wetlands (34 – 55%)
4) *Facultative upland plants* (FACU) – Only occasionally found in wetlands (1-33%)
5) *Obligate upland plants* (UPL) – May occur in wetlands of another region, but almost never occur under natural conditions in wetlands in this region (0-1%).

Because playas can serve as foci for introduction and spread of weeds (Carthell 1997), we also assigned each species a weediness rank on a scale derived from other work (Allred 1993, Foxx *et al.* 1996).

1) *Non-weedy* – a species that is not known to respond to disturbance or become an economic problem.
2) *Colonizing* - species that are part of the native flora, but increase temporarily in response to disturbances that result in clearing away vegetation; an early successional species. Examples of disturbances are flood, fire, herbivory or bulldozing. (This is similar to concept of 'increaser' used by Allred 1993).
3) *Invasive* - species which also increase in response to disturbance, but persist post-disturbance and spread rapidly and in large numbers into surrounding areas. They are often non-natives.

4) *Noxious* - species in this category occur on a noxious weed list of one of the western states (AZ, CO, UT, WY, MT, NM, TX, NV, CA) . They are generally, but not always, non-natives, and are perceived to displace or outcompete desirable native flora. They are usually an economic problem.

Vegetation data were analyzed using SAS PC (Version 6.12). We first used a gradient analysis program developed by Ludwig and Cornelius (1987) that locates discontinuities along gradient-oriented transects (gradsects) to identify vegetation zones along each transect. This procedure blocks a group of adjacent sampling points into a 'window' of a designated width, splits the window, averages the data for each variate (species cover) within each window half, computes a distance between the two groups, and moves in like fashion to each position of the transect. Plot distances are then plotted on the ordinate axis against transect positions on the abcissa. Sharp high peaks denote boundaries between adjacent vegetation zones. Sample to sample noise is eliminated iteratively by increasing the window width.

Separation between the vegetation zones was confirmed using canonical discriminant analysis. This procedure derives canonical variables that summarize the between-zone variation, in much the same way that principal components analysis summarizes total variation (SAS Institute 1989). The scores of the canonical variables indicate the degree of group differences between zones. If zones separated poorly, their boundaries were adjusted using results from the sliding window analysis.

Transit elevations were calculated and entered into Microsoft Excel to make cross section graphs. Field notes and cross section profiles were used to make topographic distinctions between the flat playa bottom (interior) and the uplands (slopes). Soils were keyed out to the fullest extent possible (to fully key out a soil, a pit should be dug to a depth of 1m), and compared with known soil information from the Soil Conservation Service's Soil Surveys of Harding, Colfax and Mora Counties.

RESULTS

Floristic Zonation

The final sliding window analyses were performed using a window size of twelve, which seemed best suited to identify breaks along the transect with a minimum of noise. Still, some zones identified with this method did not separate well when subjected to the canonical discrimination test, which was modeled to discern classes on the basis of species composition. An examination of the raw data revealed that breaks identified by the sliding window analysis were in response to differences in species cover as well as composition; therefore, it was necessary to eliminate the breaks which identified changes in species cover. This led to clearly separated zones in most cases, which were also associated with different soils (Figures 3, 4, and 5).

Most transects separated into three zones. Loosely characterized, the first zone near the center of the playa is dominated by scattered wetland plants followed by an intermediate zone commonly dominated by western wheatgrass (*Pascopyrum smithii*), a facultative grass species, and finally succeeded on the uplands by a prairie grass zone, typified by a mix of buffalo grass (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*). In the natural playas, the central wetland zone is dominated by Pennsylvania knotweed (*Polygonum pensylvanicum*), with lesser amounts of spreading yellowcress (*Rorippa sinuata*) and frogfruit (*Phyla nodiflora*). In modified playas, the central wetland zone was dominated by spreading yellowcress and succeeded by a lengthy intermediate zone dominated by western wheatgrass (Figure 1). Blue grama was also more prevalent in the upland zones of modified playas, whereas buffalo grass dominated the upland zones of the natural playas. Average cover was 35% for both modified and natural playas.

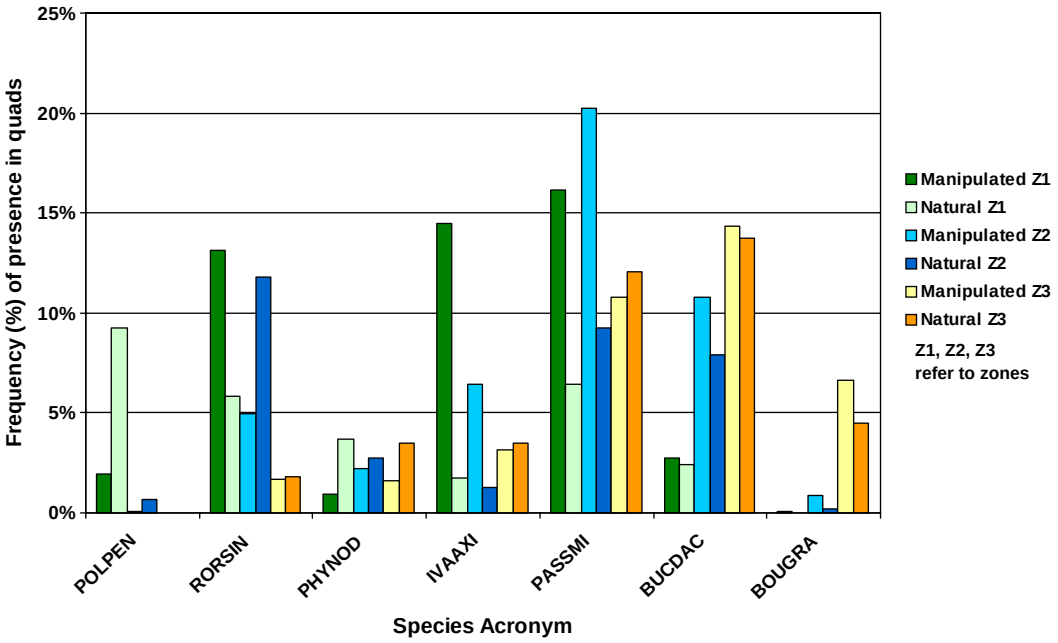
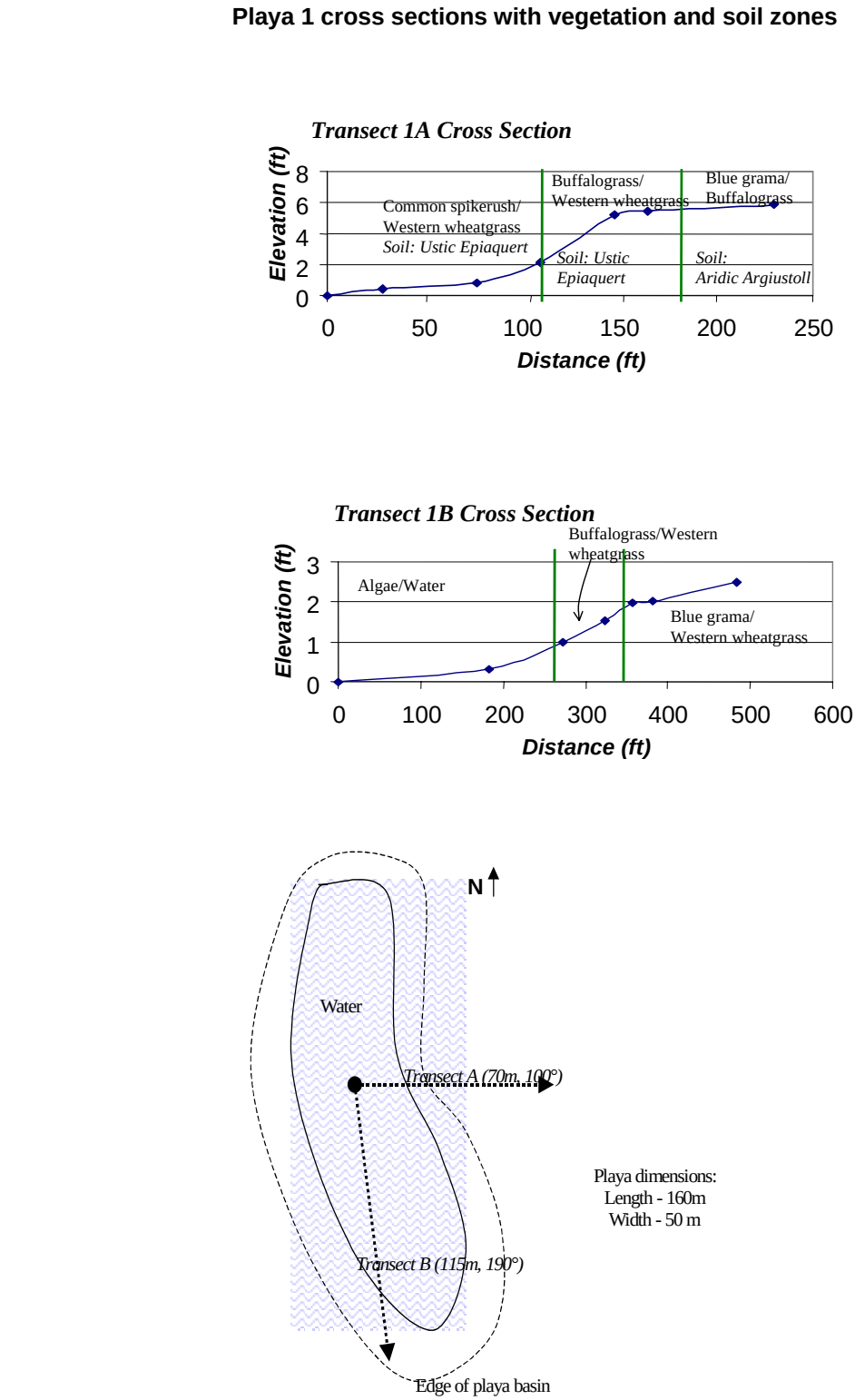


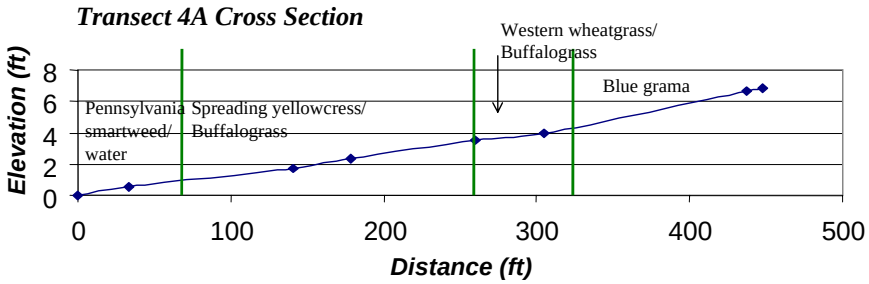
Figure 2. Relative frequencies of the most common species in manipulated and natural playas by vegetation zone (Six letter codes are acronyms. POLPEN = *Polygonum pensylvanicum,* RORSIN = *Rorippa sinuata,* PHYNOD = *Phyla nodiflora,* IVAAXI = *Iva axillaris,* PASSMI = *Pascopyrum smithii,* BUCDAC = *Buchloe dactyloides* and BOUGRA = *Bouteloua gracilis*. Z1, Z2, Z3 refer to Zone 1, 2, 3)

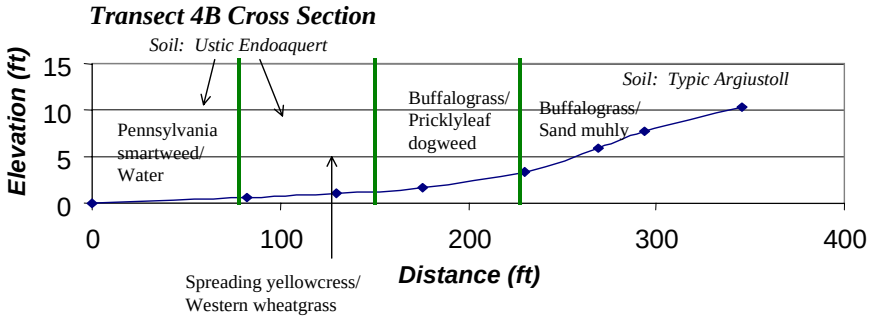
Cross sections for all playas are presented below in Tables 1 (natural playas), 2 (modified playas) and 3 (saline playas). Vertical lines separate vegetation zones, which are characterized by dominant plants. Soil taxons are also delineated on the appropriate transect.

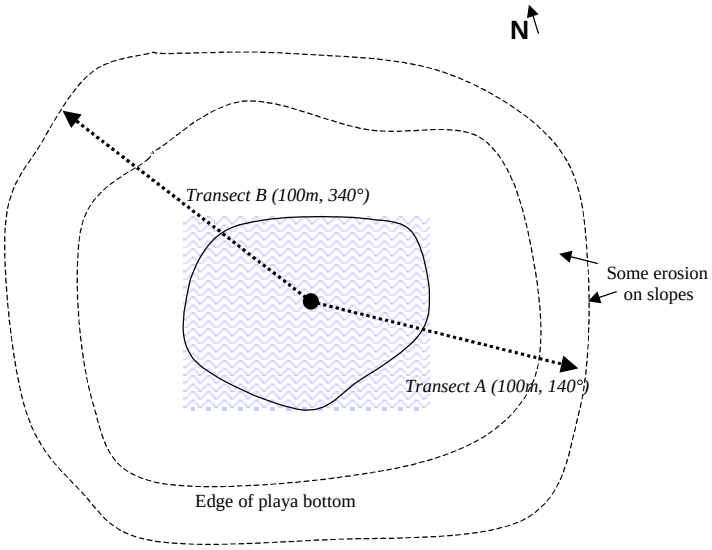
Figure 3: Cross section profiles and diagrams for natural playas.



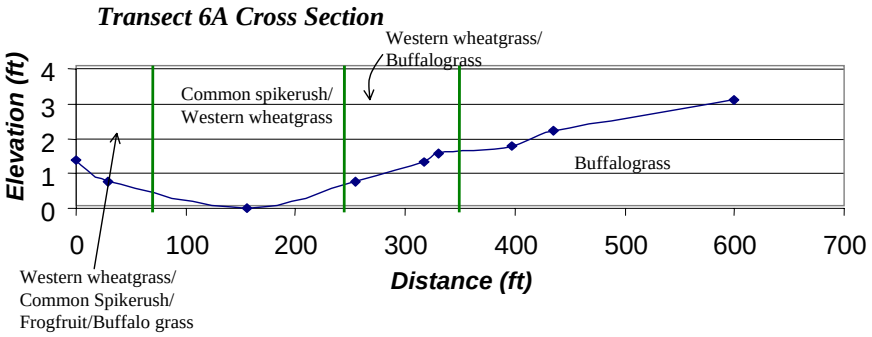
Playa 4 cross sections and vegetation zones

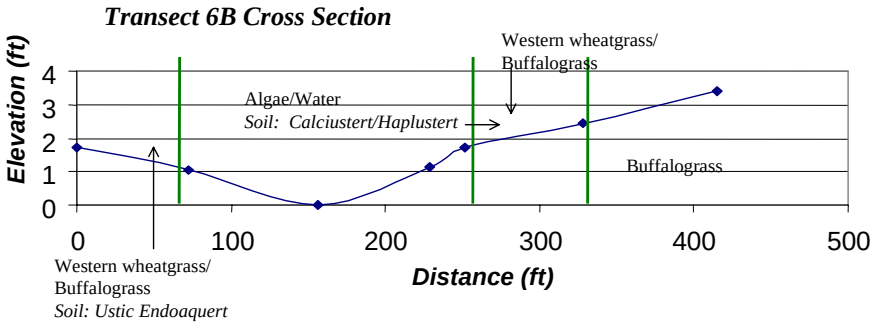


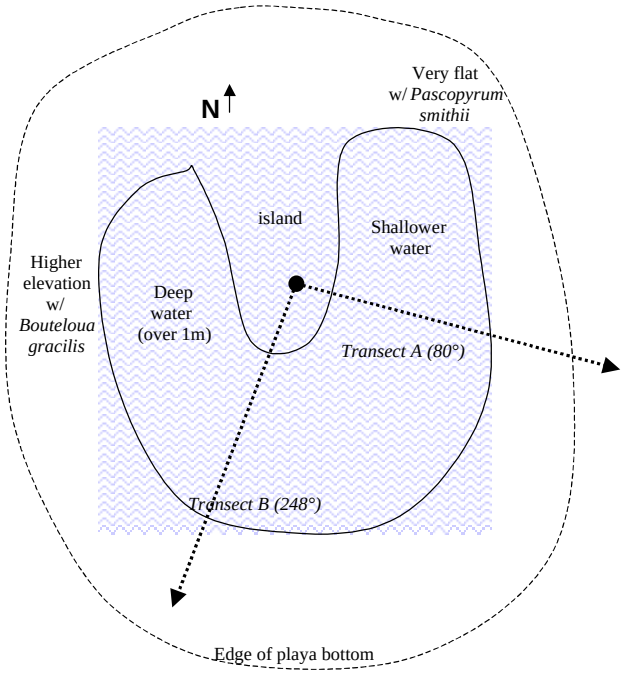




Playa 6 cross sections and vegetation zones

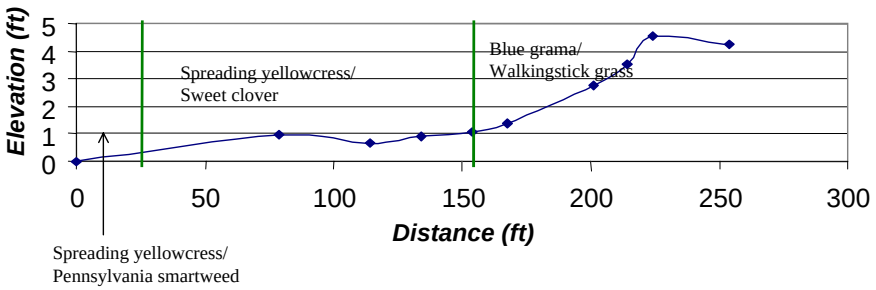




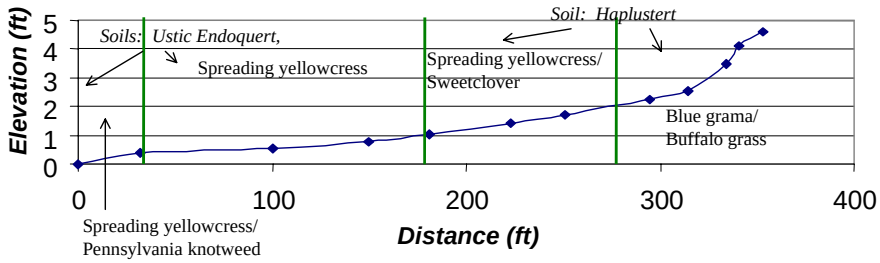


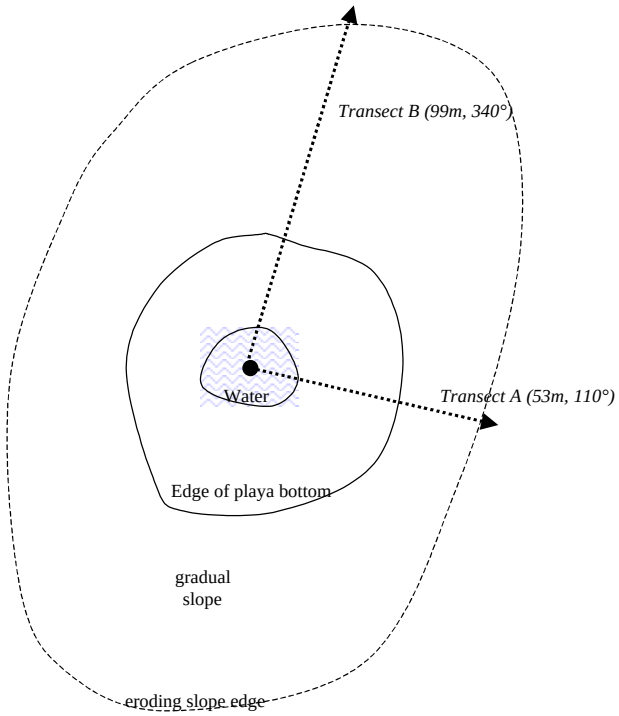
Playa 7 cross sections and vegetation zones

Transect 7A Cross Section

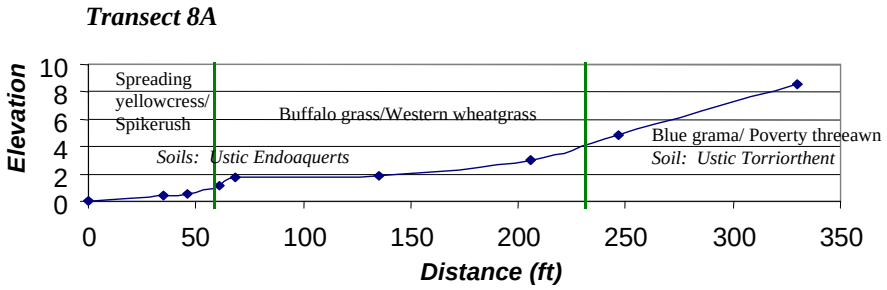


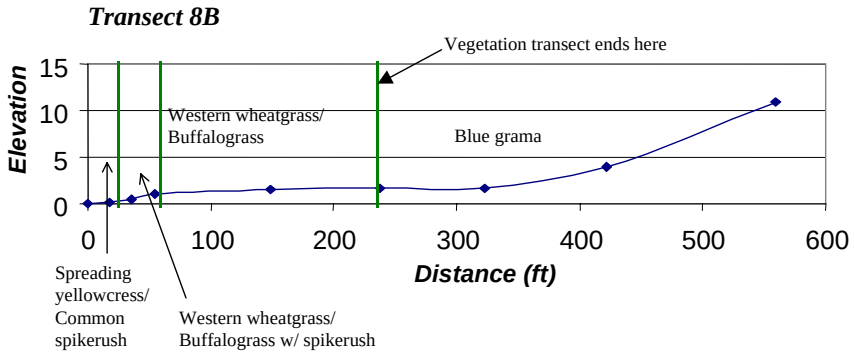
Transect 7B Cross Section





Playa 8 cross sections and vegetation zones





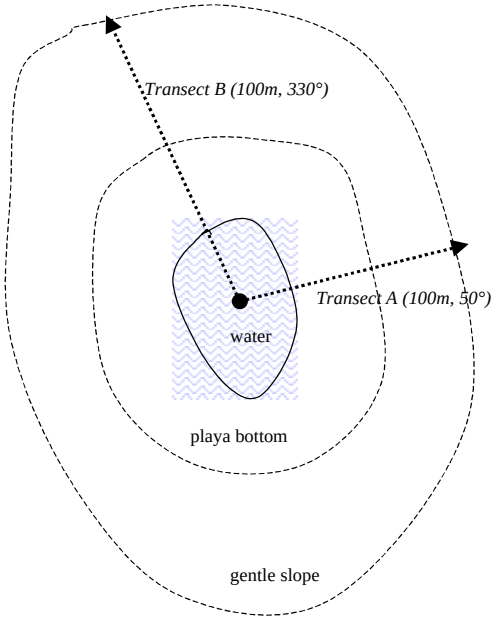
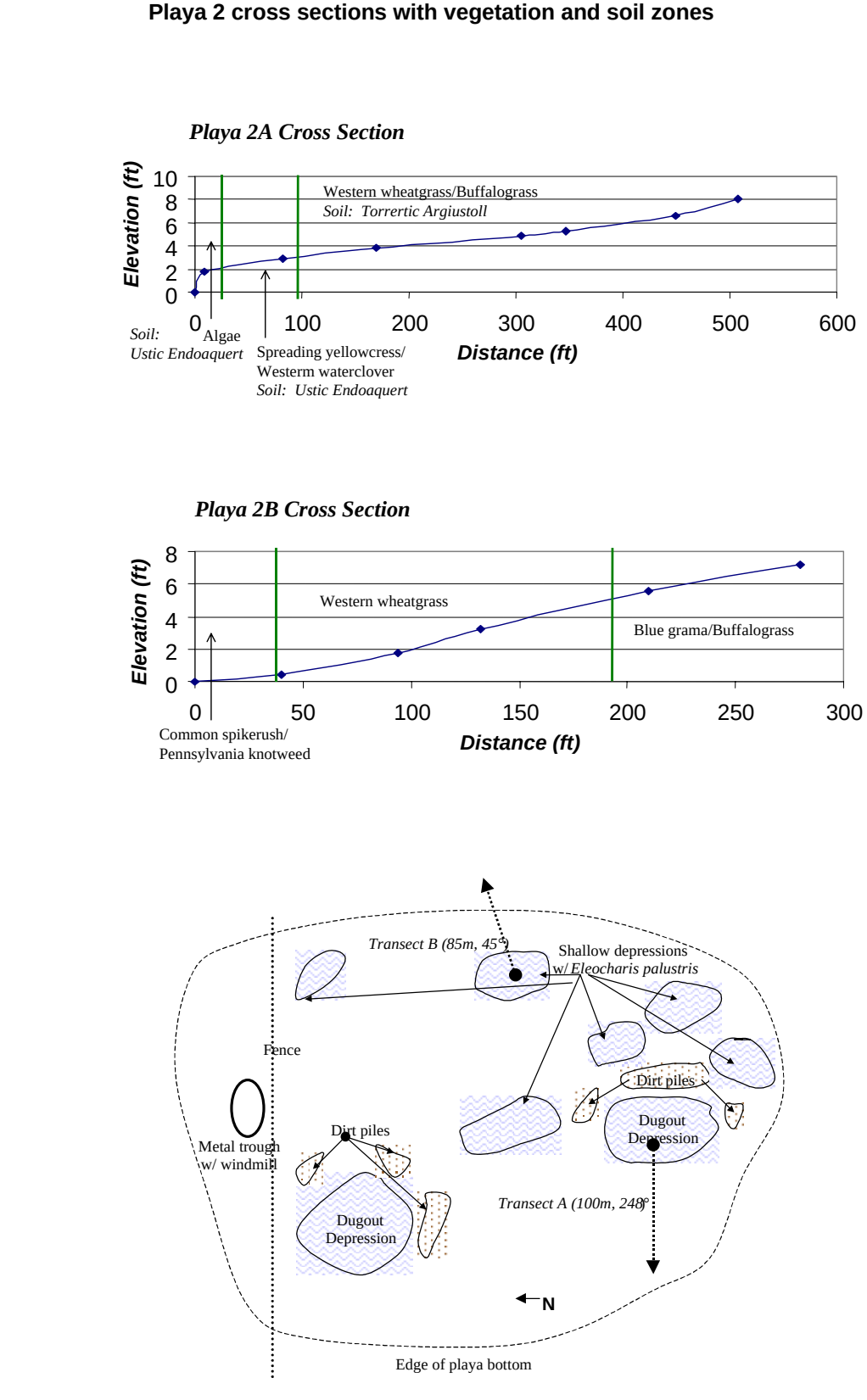
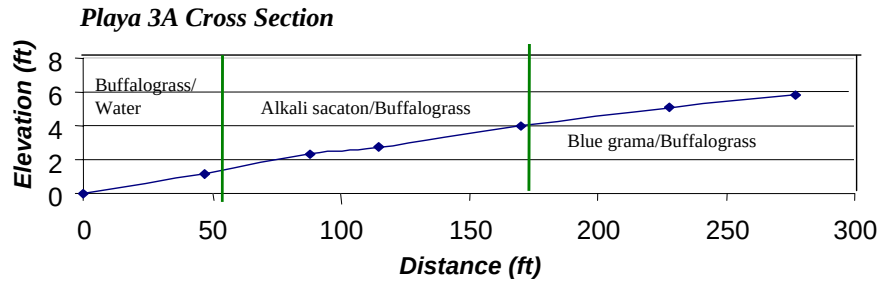
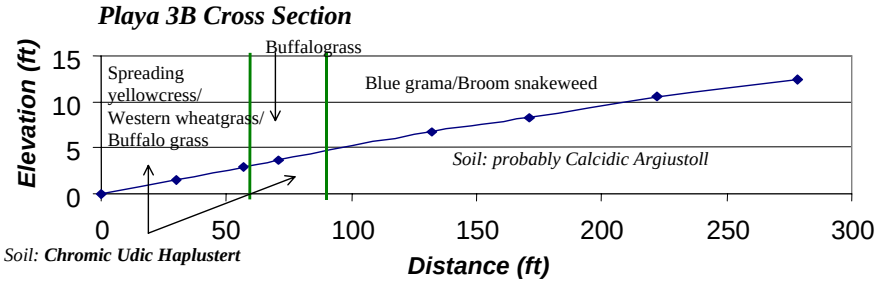


Figure 4: Cross section profiles and diagrams for modified playas.



Playa 3 cross sections and vegetation zones





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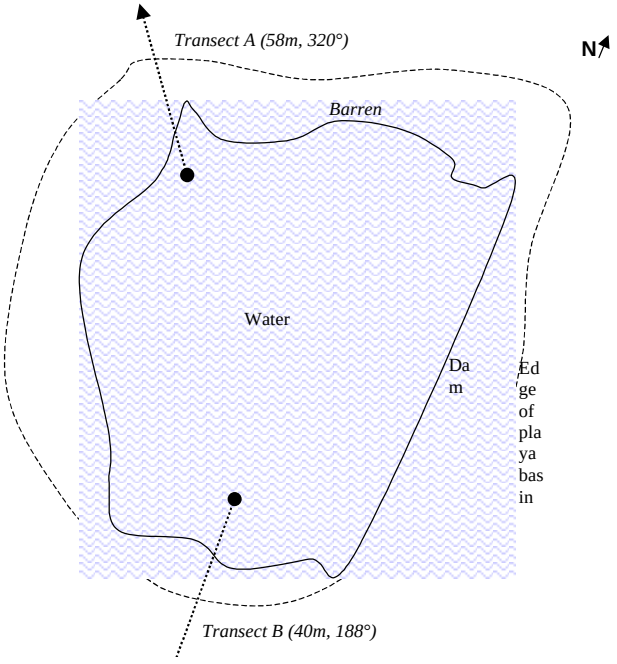
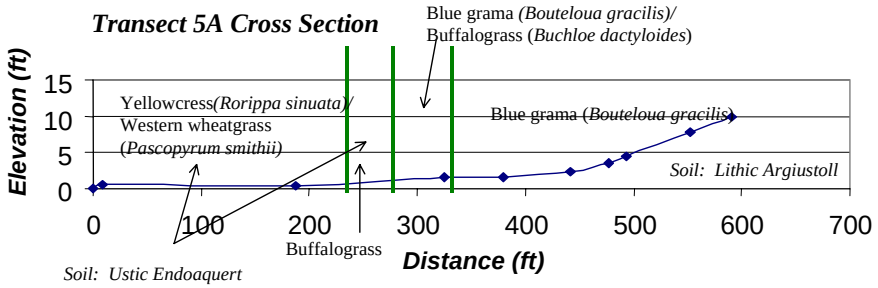
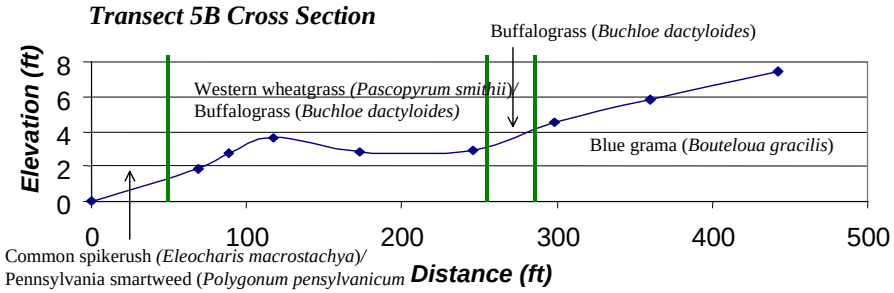
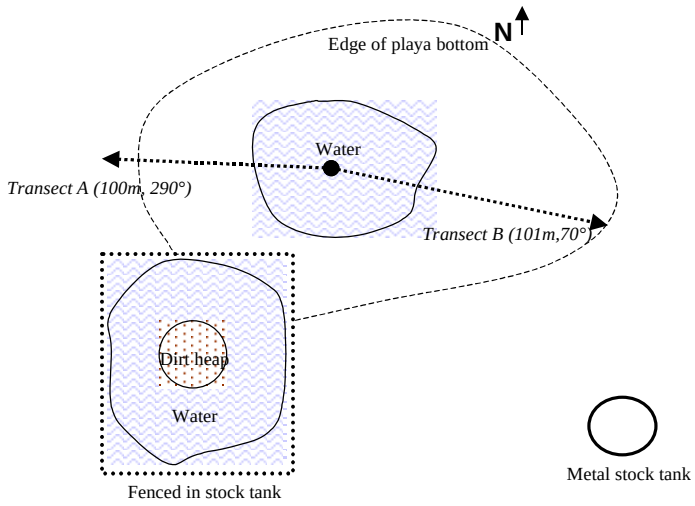


Playa 5 cross sections and vegetation zones

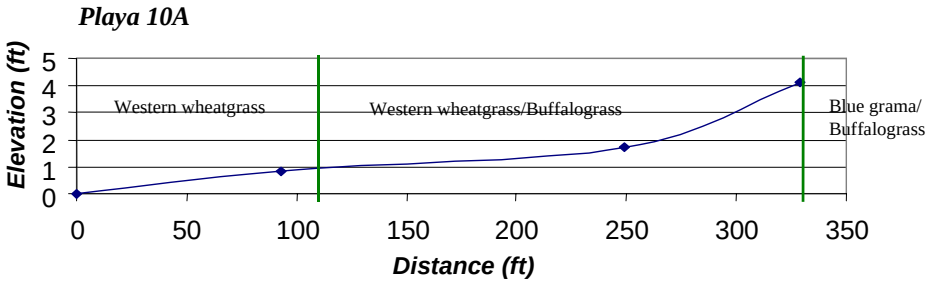


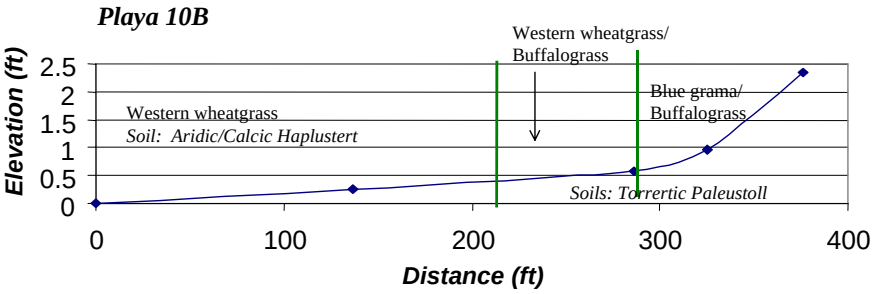


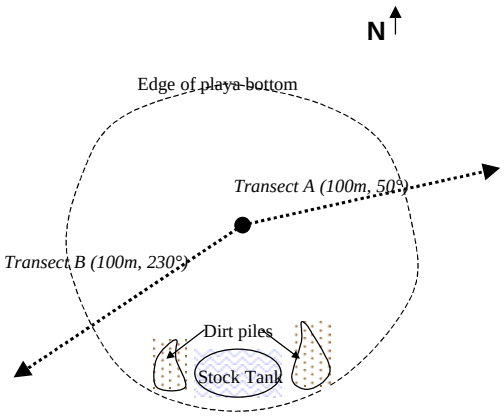


(Not to scale)

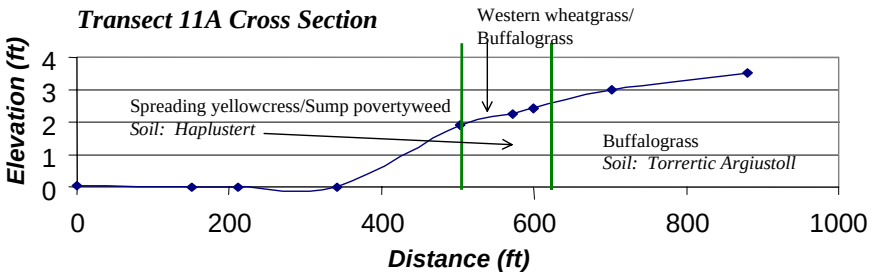
Playa 10 cross sections and vegetation zones

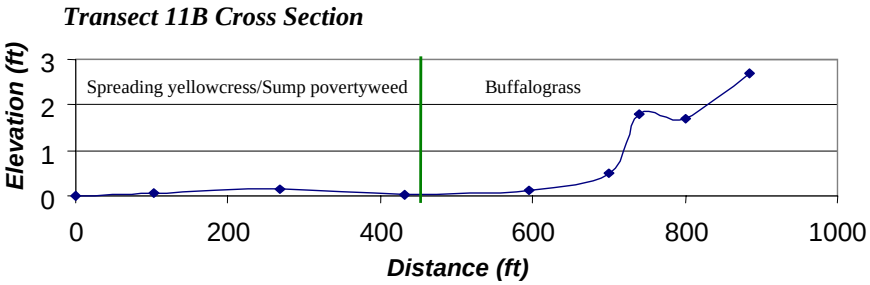






Playa 11 cross sections and vegetation zones





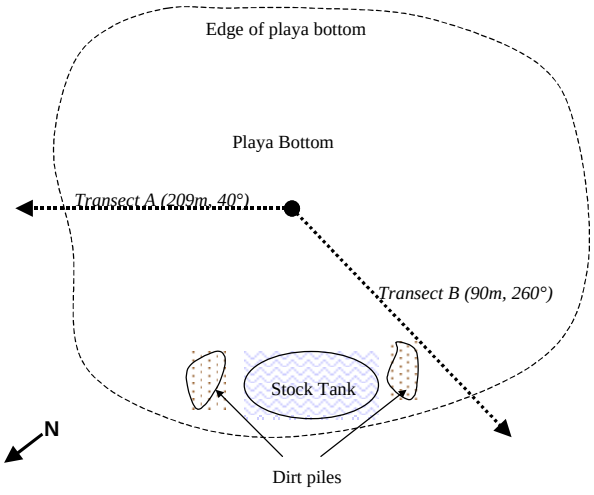
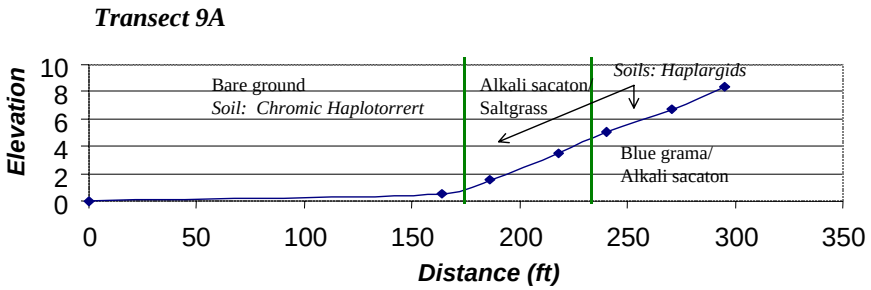
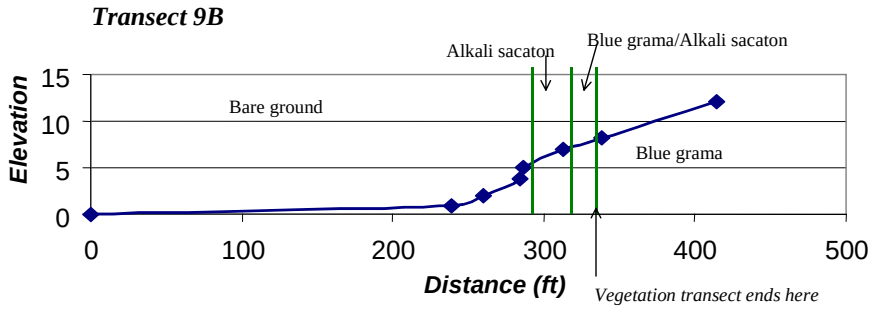
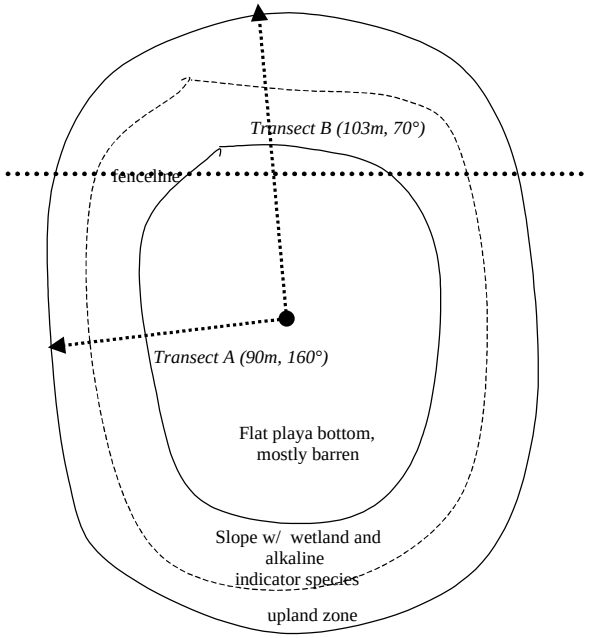


Figure 5: Cross section profiles and diagrams for saline playas.

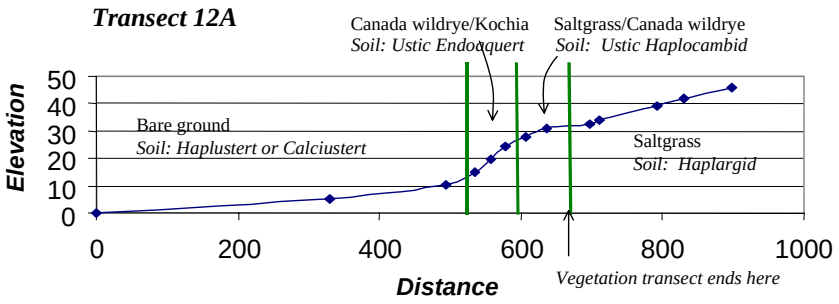
Playa 9 cross sections and vegetation zones

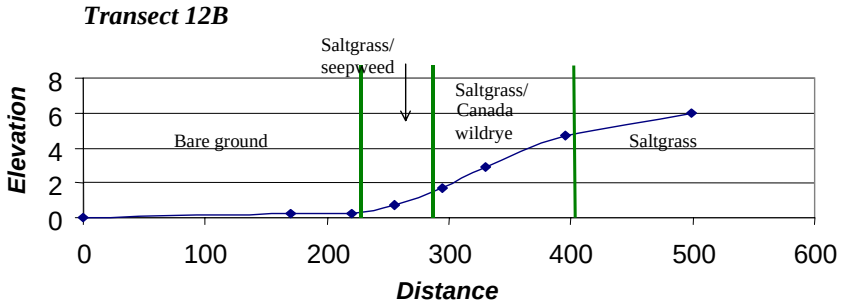


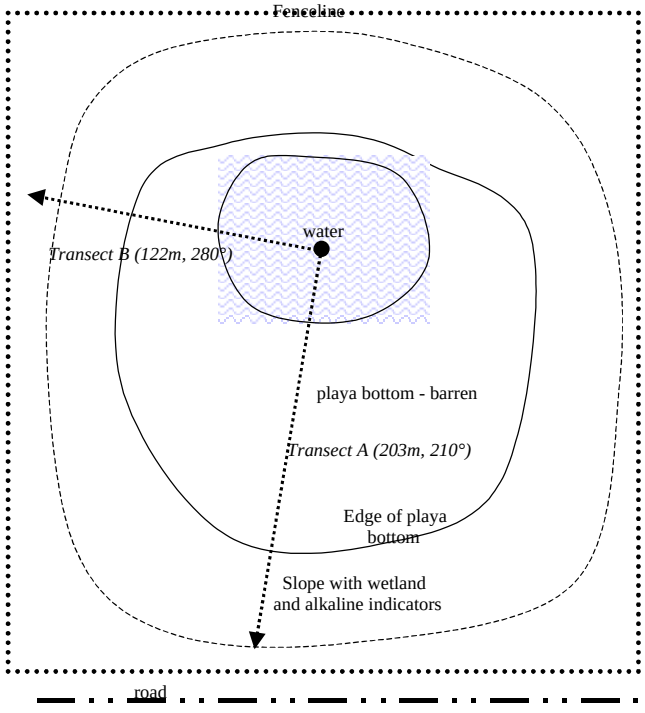




Playa 12 cross sections and vegetation zones







b

Floristic Composition and Species' Attributes

A total of 64 species were found in all playas all but fourteen of which have been previously documented as occurring in playas (Rowell 1981, Haukos and Smith 1997). The fourteen not seed before are mostly upland forbs and grasses that are components of the shortgrass prairie surrounding the playas. A list of species, along with their frequency of occurrence, topographic position, wetland status, life form, and weediness is presented in Appendix A. The number of species per playa ranges from eight (Playa 9) to 25 (Playas 7 and 8), with a median of 17 and an average of 19. The distribution of species among the playas follows the pattern of a few common species occurring in a majority of the playas with many rarer species occurring in only a few playas. Perennial grasses and forbs make up the bulk of the species, but there are nine annuals and five shrubs. Ten of the perennials possess rhizomes or stolons and are thus capable of vegetative reproduction.

Treatment differences

Playa characteristics vary considerably within treatment group, but there are some broad differences between the natural and modified playas. Although the two saline playas are included in the analyses, the sample size is too small to meaningfully compare with the other treatments. Appendix B is a compilation of each sampled playa's physical characteristics, location, vegetation and soil data.

The average number of species is 22.4 species for the natural playas, 20.5 for the modified playas, and 9.5 in the saline playas. The total vegetative ground cover for each group is fairly low at about 35% for natural and modified playas, and only 15% for saline playas. The natural and modified playas share a pool of similar species, with twelve dominants that occur in six or more playas: *Schedonnardus paniculatus, Iva axillaris, Bouteloua gracilis, Buchloe dactyloides, Pascopyrum smithii, Phyla nodiflora, Gutierrezia sarothrae, Rorippa sinuata, Astragalus* spp., *Verbena bracteata, Grindelia squarrosa* and *Polygonum pensylvanicum.* All but one (*Polygonum pensylvanicum*) are perennials. These species make up 84% of the total vegetative cover and 23% of the total 51 species found in natural playas; for the modified playas these figures are 92% of total species cover and 25% of the total 47 species.

Figure 4 shows the relative frequencies of these species, arranged by wetland status, within the two treatment types. This figure shows a trend of strongly wetland-dependent species (obligate and facultative wetland) occurring more often in natural than in modified playas. Intermediate wetland indicators (the facultative species) have the highest frequencies in the modified playas, whereas in natural playas, species are more evenly distributed between facultative wetland, facultative, and facultative upland species. Upland species are much less in evidence for both treatments, as most sampling did not occur on the uplands, but modified playas still have a greater frequency of species in this category.

Saline playas are overwhelmingly dominated by *Distichlis spicata* with *Sporobolus airoides* a distant second. It is possible that some of the *Distichlis* is actually

Muhlenbergia asperifolia (alkali muhly), as this species was recorded in 1992 at Chicosa Lake (Davis *et al.* 1993). These two species occur in the same habitat, often side by side, and are vegetatively very similar. No flowers of alkali muhly were observed during our sampling.

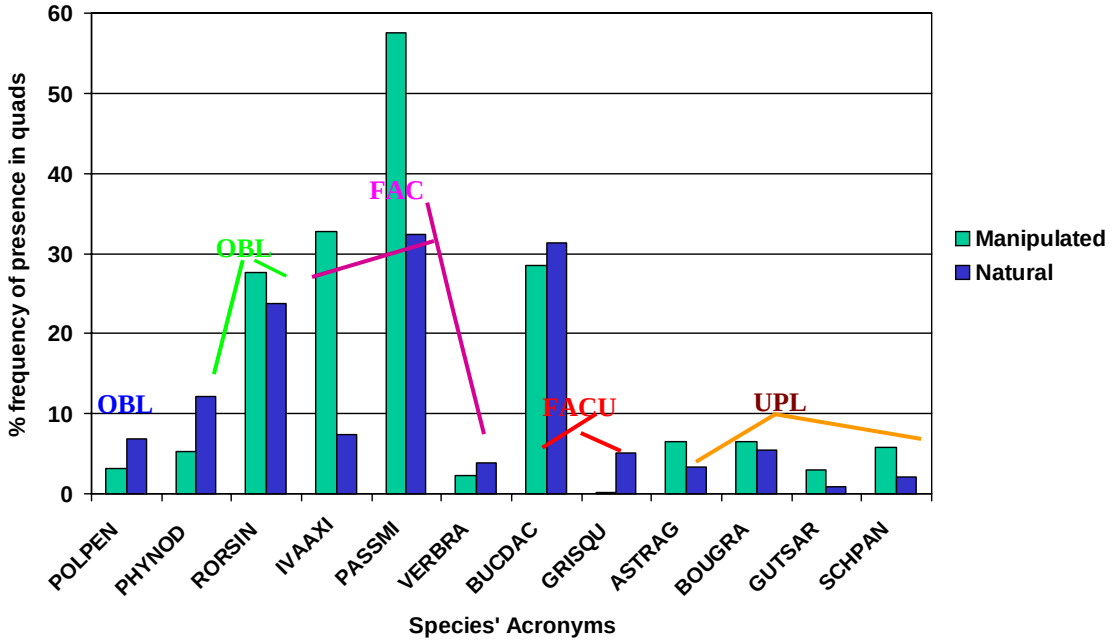


Figure 6: Relative frequencies of most common species in manipulated and natural playas, sorted by wetland status (Six letter acronyms are for plant species. POLPEN = *Polygonum pensylvanicum,* PHYNOD = *Phyla nodiflora,* RORSIN = *Rorippa sinuata,* IVAAXI = *Iva axillaris,* PASSMI = *Pascopyrum smithii,* VERBRA = Verbena bracteata, BUCDAC = *Buchloe dactyloides,* GRISQU = *Grindelia squarrosa,* ASTRAG = *Astragalus* spp., BOUGRA = *Bouteloua gracilis,* GUTSAR = *Gutierrezia sarothrae,* and SCHPAN = *Schedonnardus paniculatus.*)

Wetland Status

Only eight species of the total found in all playas are strong wetland indicators (facultative wetland or obligate wetland status), seven are facultative species and the remaining 49 are facultative upland, upland indicators or not classified as indicators. All the wetland species are found within playa interiors, but five of them (*Distichlis spicata, Phyla nodiflora, Rorippa sinuata, Eleocharis palustris* and *Schoenoplectus americanus*) extend into the upland sections, a tendency that is especially pronounced in the saline

playas where the playa interior is generally devoid of vegetation. Figures 5 and 6 show the distribution of wetland species in interiors and uplands by treatment.

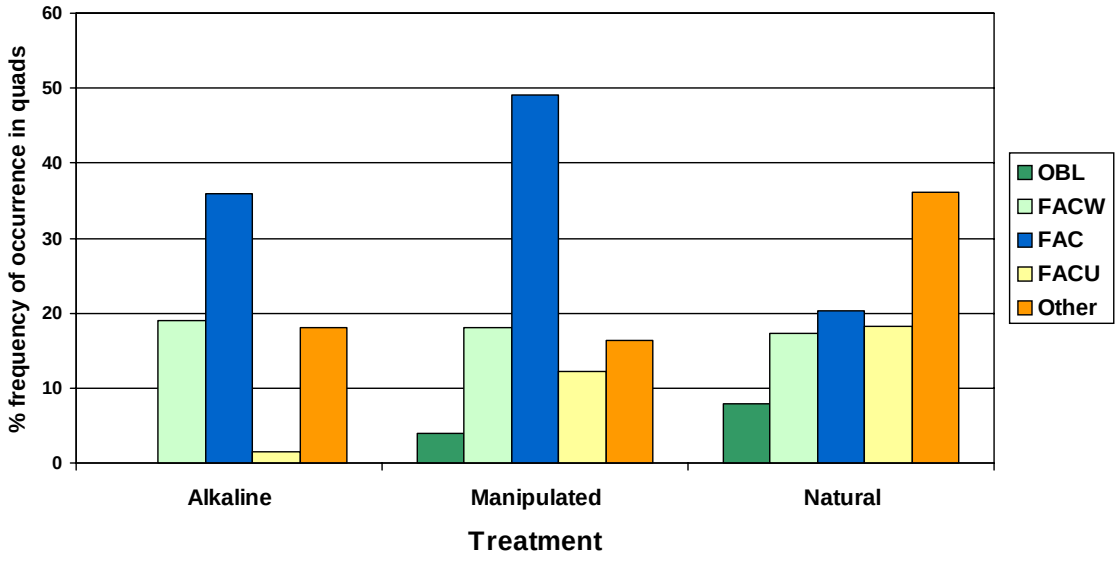


Figure 7: Wetland status of plants in playa basin bottoms

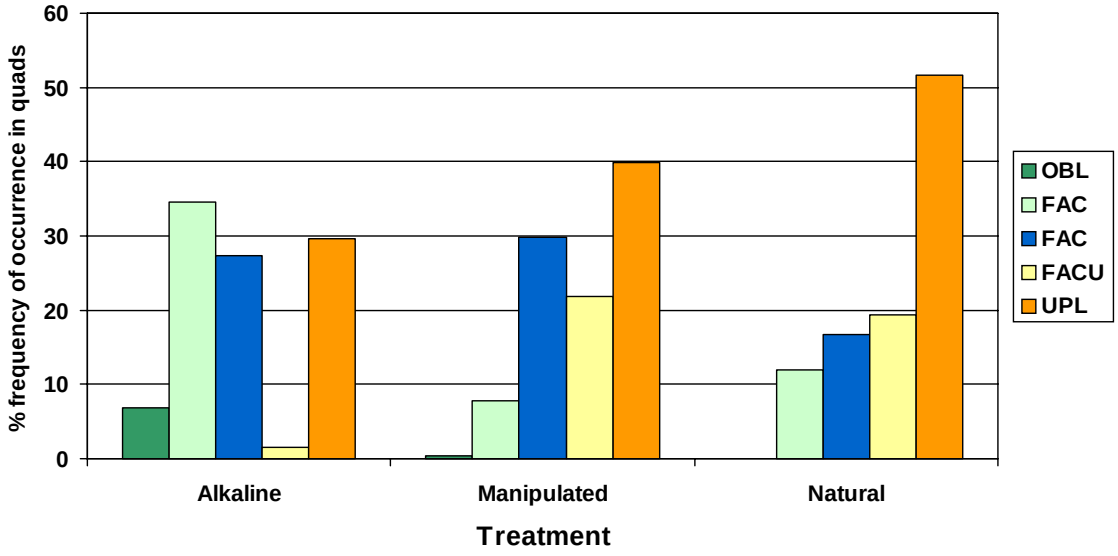


Figure 8: Wetland status of species on playa slopes

Weediness

Across all playas, a little under half the species are weedy to some degree, with the majority of these (20 species) falling into the 'colonizing' category. Three are invasive and the rest are non-weedy or unclassified. No noxious weeds were found. A comparison between the treatments (Figure 7) shows that modified playas have a greater proportion of colonizing weedy species treatments and natural playas have a greater proportion of non-weedy species.

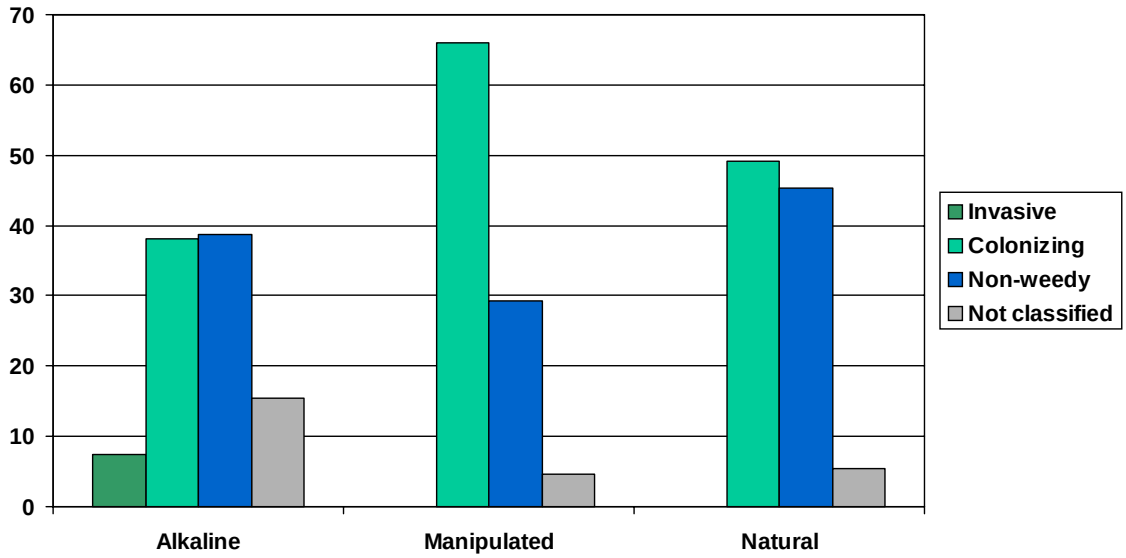


Figure 9: Proportion of weedy species in each treatment class

Soils

Soil results for each playa are presented in Appendix B, and include information from the county soil surveys. The basin bottom soils are not identified in the county soil surveys, and therefore it is not known to what series they belong.

Most soils we described in the playa basin bottoms belong to the Aquert suborder, which represent wet vertisols. Drier vertisols were identified as Usterts. The vertisols extended along the basin bottom and the lower slopes of most playas, inclusive of vegetation zones 1 and 2 of most playas. Argids and Ustoll suborders were common at the edge of playas or on the slopes. The sole Orthent was found at Playa 8 on the upland slope. Table 1 is a breakdown of the soils found during this study. Not all soils were keyed out down to sub-group.

Table 1: Soil taxa identified in playas (Not all soils were keyed out down to sub-group)

ORDER	#	SUB-ORDER	#	GREAT GROUP	#	SUB-GROUP	#
Aridisol	5	Argid	4	Haplargids	4		
		Cambid	1	Haplocambid	1	Ustic	1
Entisol	1	Orthent	1	Torriorthent	1	Ustic	1
Mollisol	9	Ustoll	9	Argiustoll	7	Calcidic	1
						Lithic	1
						Torrertic	1
						Aridic	1
						Typic	2
				Paleustoll	2	Torrertic	2
Vertisol	28	Aquert	16	Endoaquert	16	Ustic	16
		Torrert	1	Haplotorrert	1	Chromic	1
		Ustert	11	Calciustert	2		
				Haplustert	9	Aridic	1
						Chromic Udic	3

Water Chemistry

All playas by definition (>7.00 pH) were alkaline, with values ranging between 7.51 to 9.39. The two designated 'saline' playas did not have the highest pH's of the sample group. They did, however, have the highest conductance values and salinities. Conductance is a measure of electrical conductivity, which increases with dissolved salts, and it is usually well correlated with salinity. Even so, salinity values in the saline playas are very low with Playa 9 only reaching 0.01 ppt and Chicosa at 0.1 ppt. Other water chemistry attributes will be elaborated on in the forthcoming report from the New Mexico Environment Department.

DISCUSSION

Vegetation Patterns

Vegetation type and distribution of modified playas are indicative of somewhat drier conditions than their natural counterparts. In natural playas, concentrically arranged vegetation associations progress from a central zone of obligate species, such as Pennsyvania knotweed (*Polygonum pensylvanicum*) or facultative wetland species (*Phyla nodiflora, Iva axillaris*) to an intermediate zone dominated by facultative wetland and facultative species (*Pascopyrum smithii*) on the outer basin bottom to the driest zone on the basin brims dominated by upland species. Playas that have been hydromodified are

still concentrically zoned, but zones are less distinct and vegetation is more homogenous throughout the basin bottom. This homogenous vegetation is characterized by facultative species adapted to moderately dry conditions, such as western wheatgrass (*Pascopyrum smithii*) and poverty sumpweed (*Iva axillaris*), both of which are rhizomatous perennials. Although it is conceivable that the modified playas could have a central saturated zone associated with annual wetland plants in wetter years, the perennial nature of the dominant flora suggests established drier conditions.

The saline playas sampled have a markedly different vegetation pattern. Basin bottoms are uniformly flat and devoid of vegetation, save for a few small patches of saltgrass (*Distichlis spicata*). Vegetation occurs only on the slopes and is composed of wetland species which are often halophytic wetland indicators, such as saltgrass, alkali sacaton (*Sporobolus airoides*) and seepweed (*Suaeda* spp.). This pattern indicates a longer time of inundation in past years wherein plants on the basin floor perish due to high salt content and/or anoxia, but thrive at the fringes where the water table is present but receding. High levels of past inundation were probably common at Chicosa Lake, which was managed as a recreational lake until 1996, but is now dependent on incident runoff and precipitation. The lingering effects of this may be reflected in the scattered American bulrush (*Schoenoplectus americanus*) presence on the slopes, and the high elevations (to 50m) at which saltgrass, a facultative wetland species, was found.

Haukos and Smith (1994) dispute the existence of zonation in playas based on a study of playa seed banks, contending that vegetation composition is dependent on moisture availability which varies annually. However, as Guthery (1982) points out, undisturbed playas have a concentric pattern of wetting which is disrupted with modification, resulting in a patchy vegetation distribution. Other authors (Reed 1930, Bolen *et al.* 1989) have observed concentric zonation of vegetation as a prominent feature of playa lakes. Although the playas Guthery studied were more drastically modified than the playas in our study, we found a similar degradation of a concentric vegetation pattern.

Other Playa Surveys

Most other vegetation surveys of playa lakes have occurred further south and east on the Southern High Plains in Texas and southeastern New Mexico (Reed 1930, Rowell 1981, Guthery *et al.* 1982, Durkin *et al.* 1994), or Kansas (Kindscher and Lauver 1993). Elevation is lower and precipitation is higher in these areas, which is reflected in the species composition, particularly with regard to wetland species. The most comprehensive compilation of playa flora (Haukos and Smith 1997) gathers data from surveys of 41 counties within five states, finding a total of 353 species within 66 families. Twenty-eight percent of these species are obligate or facultative wetland species; 13% are facultative species and the remaining 55% are facultative upland or upland species. In comparison, we found 64 species, 14% which are obligate/facultative wetland species and 10% which are facultative species. Only nine plants were annuals – a fairly low number considering that playa vegetation may contain up to 26 annuals, many of them wetland species (Haukos 1997).

Many of the wetland species documented for playas are broadleaf emergents, which Guthery (1982) identified as a common physiognomic type occurring in shallow water of playa centers. In this study, broadleaf emergents are represented by only two species: Pennsylvania smartweed (*Polygonum pensylvanicum*) and pepperwort (*Marsilea vestita*), with pepperwort represented in only one modified playa. Pennsylvania smartweed occurs in the shallowly flooded centers of all the natural playas, and X of the modified playas. Other types of vegetation notably absent or scarce in our study, but common in others, are wetland grasses, such as vine mesquite (*Panicum obtusum*), jointgrass (*Paspalum* spp.), and orchardgrass (*Echinochloa crus-galli*); and wetland trees, such as willow (*Salix* spp.).

Species composition and vegetation patterns of our study have more in common with Hoagland and Collins (1997) survey of playas in Union and Harding counties of northeastern New Mexico and areas immediately surrounding in other states. Hoagland and Collins identified central playa zones that were dominated by western wheatgrass (*Agropyron smithii)*, buffalo grass (*Buchloe dactyloides*) and vine mesquite (*Panicum obtusum*), species that dominated the intermediate zone in our study. Otherwise, the similarity of their study with ours suggest that the lower diversity of wetland plants is due to a higher and drier climate rather than a result of the dry conditions during the sample year.

Management Implications

The hydromodification of most of the playas we studied is at least 25 - 35 years old. From a landuser's point of view, manipulating these natural water sources makes sense: they already act as water catchment areas, and deepening the pit conserves the water by limiting evaporation, reducing pumping costs and conserving precious groundwater (Carthell 1997). From an ecologist's point of view, the hydromodification of playas degrades the system by eliminating the unpredictable wet-dry cycle to which playa vegetation is adapted (Haukos *et al.* 1992) and reducing the area of inundation which limits wildlife habitat (Bolen *et al.* 1989).

There are several benefits to maintaining playas in a natural condition. Playas are a major source of water recharge to underlying aquifers (Wood and Osterkamp 1984, Nativ and Riggio 1990, Scanlon *et al.* 1994, Zartman *et al.* 1994), and thus are vital to the continued productivity and health of a region. Periodic inundation promotes aquatic plant growth which curtails erosion and improves water quality (Sublette and Sublette 1967), and inundation can also check establishment of weeds that colonize the bare soil of playas and spread to the uplands (Carthell 1997). Wildlife habitat is enhanced with aquatic vegetation and when water spreads out over a wide area. While many landusers may not consider maintenance wildlife habitat an economic benefit, there are a number of government programs and private conservation groups that are eager to provide technical and financial assistance to landusers without loss of control (Carthell 1994, Dierauf

1994). Foremost among these is the Playa Lakes Joint Venture[5] which encourages restoration or development of wildlife habitat.

Restoration of rangeland playas is likely to be less costly than that of playas used for cropping or catchment basins for oil waste. Rangeland playas are simply not as degraded as other playas, evidenced by substantially less sedimentation from erosion (Luo *et al.* 1997), and essential preservation of a concentric vegetation pattern (Guthery *et al.* 1982). In some cases, restoration would merely require filling in a pit, although restoration data from the functionally similar prairie pothole region indicates it may be some years before a full complement of vegetation returns (Galatowitsch and van der Valk 1996). A playa basin may also be divided so that part can be devoted to stock tank use while retaining the essential characteristics of the basin in another part, such as occurs at Playa 5. For other modified playas, such as Playa 3, a large perennial lake and resting area for migrating waterfowl, it would be impractical to return to intermittent playa lake conditions, but the playa could benefit from establishing vegetation along the bank to reduce erosion and sedimentation of the basin. Within each parcel, it should be possible to have a range of playas that fulfill the rancher's need for water and also be ecologically functional wildlife habitat.

Future Study

The sampling density for this study was high, with over 5,000 quadrats read for twelve playas. The concentric arrangement of vegetation in playas lends itself to a lower sampling density within a stratified (by plant association) sampling design. Time saved on sampling could be allocated to increasing the sample size, so that variation or the lack of it is more fully characterized for an area.

A seed bank study done in conjunction with the above-ground study would also help assess the potential vegetation of playas especially when repeat sampling is limited. Playas can have substantial seed banks, in terms of both numbers and diversity, even though some seeds may germinate only rarely under unusual moisture conditions (Haukos and Smith 1993, 1994).

Playa lakes are tremendously valued for their wildlife habitat value, but very little has been done on what impact the wildlife has on the habitat. For playas and other disconnected wetlands, seed transport by migrating waterfowl may be critically important to local vegetation dynamics. The single study of seed dispersal by waterfowl (done in New Jersey) found that more than 75% of the birds were carrying seeds of up to 12 species on their feathers (Viviansmith and Stiles 1994). Such seed transport between playas could have a tremendous impact on playa vegetation depending on the time of year and condition (wet or dry) of the playa.

Mode(s) of water loss should also be investigated more closely, specifically the ratio of percolation to evaporation in modified and unmodified playas. A limited study of

[5] A list of people and agencies involved with this group can be found on http://www.npwrc.usgs.gov/npscinfo/jointven/jointven.htm

a single playa lake in Lubbock (Reed 1930) found that percolation apparently accounts for more water loss than evaporation. Since then, several authors have found ample evidence for percolation through the clays of the playa center (Scanlon *et al.* 1994, Zartman *et al.* 1994), surfaces which were previously thought to be only slightly permeable (Osterkamp and Wood 1987). Evaporation may also enrich or purify water before it is deposited in groundwater (Nativ and Riggio 1990), perhaps contributing to water quality or even be a vital part of the recharge process.

Conclusions

General drier conditions of playas within the study area are probably due to climatic and longitudinal factors in combination with hydromodification. Northeastern New Mexico is at the highest elevation and the furthest point west for the playa lake region, where precipitation can be 20-80cm less than that received elsewhere in the High Plains (Sims 1988). Overall, hydromodification in this region, although widespread, is not impacting playas to the extent that has occurred in other regions, particularly where playas are used for polluted irrigation water runoff (in Texas and Kansas) or oil waste dumping (southeastern New Mexico). Playa use and wildlife habitat should be compatible in this region.

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Appendix A: List of all species found in sampled playas

Species are grouped by family, and listed alphabetically. The '# Playas' refers to the number of playas each species occurs in; 'Treatment' codes combine position and treatment with I=Interior, U=Upland, N=Natural, M=Modified and A=Alkaline; 'Frequency' is the number of times each species was encountered; 'Wetland Status' categories follow Reed (1997) explained in the text; 'Life Form' incorporates life cycle, life form and presence of vegetative reproductive structures; 'Weediness' follows the categories explained in the text.

Family	***Species Name/Authority***	***# Playas***	***Treatment***	***Frequency***	***Wetland Status***	***Life Form***	***Weediness***
Amaranthaceae	*Amaranthus* spp.	2	IM UM	11			
Amaranthaceae	*Amaranthus palmeri*	1	UA	2		Annual forb	Colonizing
Asteraceae	*Cirsium* spp.	1	IM UM	9		Short-lived perennial	
Asteraceae	*Artemisia frigida*	4	IM UM UN	15		Perennial sub-shrub	Colonizing
Asteraceae	*Berlandiera lyrata*	1	UN	14		Perennial forb	Non-weedy
Asteraceae	*Chaetopappa ericoides*	2	IM UN	9		Perennial forb	Non-weedy
Asteraceae	*Conyza canadensis*	1	UA	8	FACU	Annual forb	Invasive
Asteraceae	*Dyssodia papposa*	1	UN	125		Annual forb	Colonizing
Asteraceae	*Erigeron flagellaris*	2	IM IN UM UN	38	FAC-	Short-lived perennial	Non-weedy
Asteraceae	*Grindelia squarrosa*	7	IM IN UM UN	102	FACU	Short-lived perennial	Colonizing
Asteraceae	*Gutierrezia sarothrae*	8	IM IN UA UM	81		Perennial sub-shrub	Colonizing
Asteraceae	*Hymenopappus* spp.	1	UN	1		Perennial forb	Non-weedy
Asteraceae	*Iva axillaris*	10	IM IN UM UN	839	FAC	Rhizomatous forb	Colonizing
Asteraceae	*Ratibida tagetes*	5	IM IN UM UN	116		Perennial forb	Non-weedy
Asteraceae	*Senecio multicapitatus*	1	UN	1		Perennial forb	Non-weedy
Asteraceae	*Thelesperma megapotamicum*	2	UN	9		Perennial forb	Non-weedy
Asteraceae	*Thymophylla acerosa*	1	IN UN	117		Perennial forb	Non-weedy
Brassicaceae	*Rorippa sinuata*	8	IM IN UM UN	1044	FACW	Rhizomatous forb	Colonizing
Cactaceae	*Opuntia phaeacantha*	1	UA	1		Perennial shrub	Non-weedy
Cactaceae	*Opuntia* spp.	1	IM	1		Perennial shrub	
Chenopodiaceae	*Suaeda* spp.	1	IA UA	65		Annual forb	Colonizing
Chenopodiaceae	*Atriplex canescens*	2	UM	8	UPL	Dioecious shrub	Non-weedy
Chenopodiaceae	*Kochia scoparia*	1	IA UA	36	FAC	Annual forb	Invasive

Family	Species Name/Authority	# Playas	Treatment	Frequency	Wetland Status	Life Form	Weediness
Cuscutaceae	*Cuscuta* spp.	3	IN UN	13		Parasitic	Non-weedy
Cyperaceae	*Eleocharis palustris*	4	IM IN UM	222	OBL	Rhizomatous sedge	Non-weedy
Cyperaceae	*Eleocharis* spp. R. Br.	5	IN UN	103		Rhizomatous sedge	
Cyperaceae	*Schoenoplectus americanus*	1		38	OBL	Rhizomatous sedge	Non-weedy
Cyperaceae	*Schoenoplectus tabernaemontani*	1	IM	8	OBL	Rhizomatous sedge	Non-weedy
Cyperaceae	*Scirpus* spp.	1	IN	30		Perennial sedge	
Euphorbiaceae	*Chamaesyce* spp.	1	IM UN	3		Perennial forb	
Euphorbiaceae	*Euphorbia marginata*	1		1		Annual forb	Non-weedy
Fabaceae	*Astragalus* spp.	8	IM IN UA UM UN	226		Perennial forb	
Fabaceae	*Melilotus officinalis*	4	IM IN UA UM UN	95	FACU+	Short-lived perennial	Colonizing
Fabaceae	*Oxytropis* spp	2	IN UN	6		Perennial forb	Colonizing
Fabaceae	*Vicia americana*	1	IN	1	FACU	Perennial forb	Non-weedy
Lamiaceae	*Hedeoma drummondii*	2	IM IN	6		Perennial forb	Non-weedy
Lamiaceae	*Hedeoma* spp.	1	UN	1		Perennial forb	
Linaceae	*Linum lewisii*	3	IM IN UM UN	10		Perennial forb	Non-weedy
Malvaceae	*Sphaeralcea coccinea*	2	UM UN	9		Perennial forb	Colonizing
Malvaceae	*Sphaeralcea* spp.	5	IM IN UM UN	52		Perennial forb	
Marsileaceae	*Marsilea vestita*	1	IM UM	25		Rhizomatous forb	Non-weedy
Poaceae	*Aristida divaricata*	5	IN UM UN	92		Perennial grass	Colonizing
Poaceae	*Bouteloua barbata*	1	IN	1		Annual grass	Colonizing
Poaceae	*Bouteloua gracilis*	10	IM IN UA UM UN	285		Perennial grass	Non-weedy
Poaceae	*Buchloe dactyloides*	10	IM IN UM UN	1211	FACU	Dioecious, stoniferous grass	Non-weedy
Poaceae	*Chloris verticillata*	1	UA	10		Perennial bunch grass	Colonizing
Poaceae	*Digitaria cognata*	1	UA	1		Perennial bunch grass	Non-weedy
Poaceae	*Distichlis spicata*	3	IA UA UM	220	FACW	Dioecious, rhizomatous grass	Colonizing
Poaceae	*Echinochloa crus-galli*	3	IN UN	12	FACW-	Annual grass	Colonizing
Poaceae	*Elymus canadensis*	1	UA	57	FAC	Perennial bunch grass	Non-weedy
Poaceae	*Elymus elymoides*	1	UN	1	UPL	Perennial bunch grass	Colonizing
Poaceae	*Lycurus setosa*	1	UN	7		Perennial bunch grass	Non-weedy

Family	*Species Name/Authority*	*# Playas*	*Treatment*	*Frequency*	*Wetland Status*	*Life Form*	*Weediness*
Poaceae	*Muhlenbergia arenicola*	1	UN	39		Perennial bunch grass	Non-weedy
Poaceae	*Muhlenbergia torreyi*	1	UM	2		Rhizomatous grass	Non-weedy
Poaceae	*Pascopyrum smithi*i	10	IM IN UM UN	1851	FAC-	Rhizomatous grass	Colonizing
Poaceae	*Schedonnardus paniculatus*	11	IM IN UA UM UN	170		Perennial grass	Colonizing
Poaceae	*Sporobolus airoides*	3	IM IA UA UM	110	FAC	Perennial bunch grass	Non-weedy
Poaceae	*Sporobolus cryptandrus*	1	IM UM	10	FACU-	Perennial bunch grass	Colonizing
Polygonaceae	*Polygonum pensylvanicum*	7	IM IN	198	OBL	Annual forb	Non-weedy
Solanaceae	*Solanum rostratum*	1	UN	2		Annual forb	Invasive
Verbenaceae	*Tetraclea coulteri*	1	IN	1		Perennial forb	Non-weedy
Verbenaceae	*Verbena bracteata*	8	IN UM UN	124	FAC	Perennial forb	Colonizing
Verbeneaceae	*Phyla nodiflora*	10	IM IN UM UN	350	FACW	Perennial forb	Non-weedy

Appendix B: Playa Location Data and Physical Descriptions

Specific data for each playa are presented here, including sampling date, estimated size, and water chemistry (with data obtained from New Mexico Environment Department), soils and floristic lists. Locational data is accompanied by topographic maps. Descriptive field observations on the water features, landscape and vegetation are also presented.

PLAYA 1

Sampled: October 6, 1998
Treatment: Natural
Estimated size: 6.5 acres

Location

Quad Map: Alto de Hormiga
County: Mora
Elevation: 6302 ft.
***UTM's*:** N3994822 E534198
***Lat/Long*:** 36.0491, 104.6244
Township/Range/Section: T22N R22E, SEC32
Local Directions: At Levy, 19 miles south of Springer, cross the railroad tracks to the east, and enter a yellow gate. (If this gate is locked, follow the railroad tracks to the north for about ¼ mile to another gate.) Turn north and follow the paved road for about ½ mile. Turn east and go towards a water tank that is visible about ½ mile east. Follow the road east from this tank to a second tank until a gate is reached. Go through the gate and follow the fence east to the two playas that are located here; this is the second playa to the east.

Water Features: Moderately deep, fully inundated playa with very low salinity. Not very mucky and easy to walk in. Lots of vegetation on bottom, but it is obscured by water.

pH = 8.32; specific conductance = 302 μmohs; salinity = 0 ppt.

Landscape Features: Playa is within gently sloping rolling hills. The basin is kidney bean shaped and relatively well defined. Cut banks with about 1 foot exposed soil occur are noticeable on the east bank.

Vegetation Description: Cover in Zone 1 is mostly water, bare soil and litter, with scattered vegetation accounting for less than 1% in Transect B but about 10% in Transect A. These include the obligate wetland species common spikerush (*Elocharis palustris*), with facultative species western wheatgrass (*Pascopyrum smithii*), and poverty sumpweed (*Iva axillaris*). Buffalo grass (*Buchloe dactyloides*) is present in Zone 1 at low levels, but dominates Zone 2 at high cover levels, co-occurring with patches of locoweed (*Astragalus* spp.) and western wheatgrass. Zone 3 represents the surrounding uplands and is a Blue grama-Buffalo grass (*Bouteloua gracilis -Buchloe dactyloides*) grassland community, with western wheatgrass still present on the relatively gradual slope of Transect B. Composites, such as prairie coneflower (*Ratibida tagetes*) and snakeweed (*Gutierrezia sarothrae*) increase upslope.

Wildlife/Livestock: Pronghorn, killdeer, tiger salamander in neotonic stage, ducks and lots of cows.

Soils

Surrounding soils (Mora County Soil Survey)

The surrounding soils are mostly Vermejo silty loams, with shale alluvium parent material. Fine, mixed (calcareous), mesic Ustic Torriorthents is the primary soil taxon surrounding this playa.

Basin soils (sampled along Transect A)

Zone 1: Ustic Endoquert

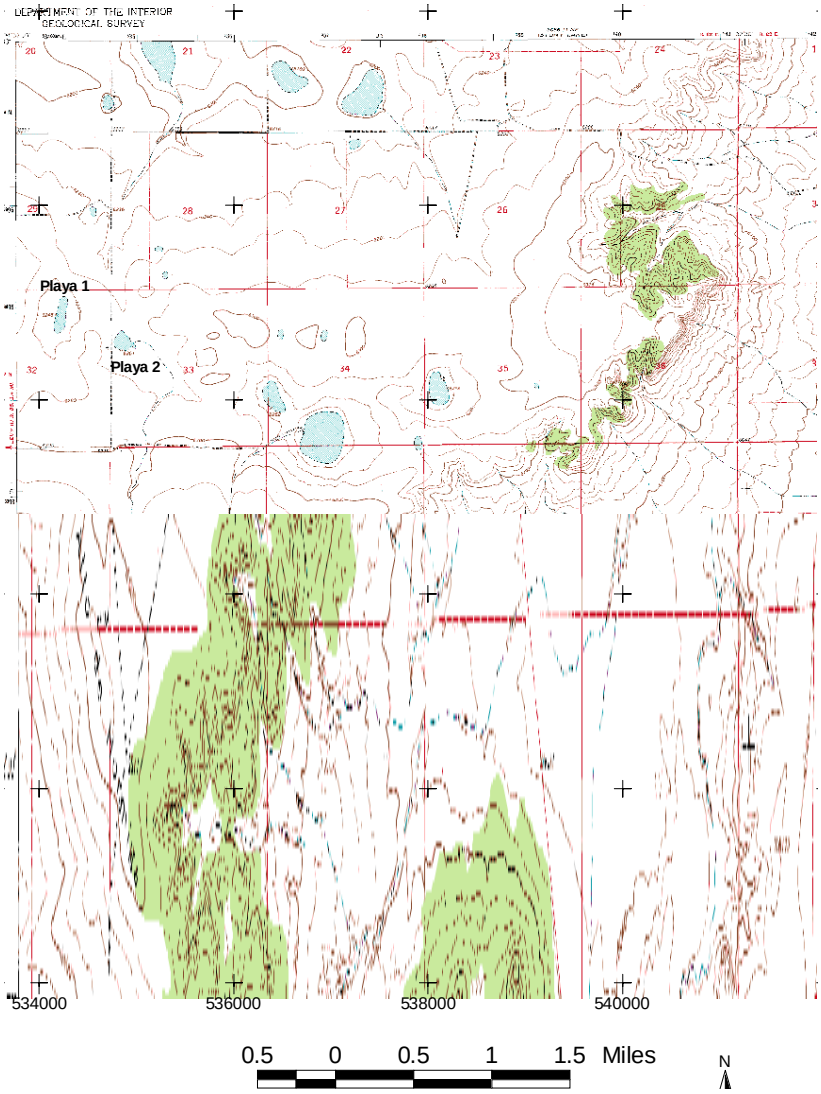
C1: 0-30cm; dark grayish brown (10YR 4/2 ped/moist); clayey (95% clay); few medium and few fine roots in upper 10cm.
Sample location: Station 3 at waters edge.

Zone 2: Ustic Endoquert

A1: 0-2cm; gray (10YR 5/1 ped/dry); clay loam (40% clay), dark gray (10YR 4/1 rub/moist); medium platy; common fine roots; clear boundary.
C1: 2-30cm; dark grayish brown (10YR 4/2 ped/dry); clayey (90% clay), black (2.5Y 4/1 rub/moist); coarse subangular blocky; few fine roots; few calcic nodules.
Sample location: Station 4

Zone 3: Aridic Argiustoll

A1: 0-2cm; gray (10YR 5/1 ped/dry); clay loam (40% clay), dark gray (10YR 4/1 rub/moist); medium platy; many fine roots; clear boundary.
C1: 2-40cm; grayish brown (10YR 5/2 ped/dry); clay loam (75% clay), dark gray (10YR 4/1 rub/moist); medium subangular blocky; few fine roots; common calcic nodules.
Sample location: Station 7



Locations of Playas 1 and 2, Alta Hormiga Quadrangle

Average cover type values for Playa 1, Transect A

		Mean cover (%)		
Species Name	**Wetland status**	**Zone 1**	**Zone 2**	**Zone 3**
Algae/Cyanobacteria		0.18		0.12
Astragalus spp.			2.20	
Bare Soil		18.09	40.73	4.71
Bouteloua gracilis			1.53	32.69
Buchloe dactyloides	FACU	1.94	41.10	52.98
Eleocharis palustris	OBL	2.07		
Grindelia squarrosa	FACU		0.07	
Gutierrezia sarothrae				0.43
Hedeoma spp.			0.07	
Iva axillaris	FAC	1.09	0.70	0.43
Litter		2.54	8.77	8.36
Pascopyrum smithii	FAC-	2.94	2.13	0.10
Phyla nodiflora	FACW		1.57	0.10
Ratibida tagetes			0.33	0.05
Rorippa sinuata	FACW	0.25	0.40	
Schedonnardus paniculatus			0.20	
Unidentified forb		0.03	0.37	0.02
Water		70.88		
# quadrats		68	30	42

Average cover type values for Playa 1, Transect B

		Mean cover (%)		
Species Name	**Wetland Status**	**Zone 1**	**Zone 2**	**Zone 3**
Algae/Cyanobacteria		0.16		
Astragalus spp.			0.02	1.47
Aristida divaricata		0.02		
Bare Soil		5.56	51.69	5.63
Bouteloua gracilis				2.11
Buchloe dactyloides	FACU	0.57	53.86	54.68
Iva axillaris	FAC	0.01	0.27	0.11
Litter		8.25	3.12	23.68
Oxytropis spp			0.37	1.16
Pascopyrum smithii	FAC-		4.43	7.37
Phyla nodiflora	FACW		0.14	0.84
Ratibida tagetes		0.01		1.26
Rorippa sinuata	FACW	0.01		0.26
Unidentified forb			0.57	0.79
Verbena bracteata	FAC			1.00
Water		85.42		
# quadrats (n):		161	49	19

PLAYA 2

Sampled: October 19, 1998
Treatment: Modified
Estimated Size: 14+ acres

Location

Quad Map (1:24,000): Wagon Mound
County: Mora
Elevation: 6282'
UTM's: N3994821 E532872
Lat/Long: 36.0941, 104.6423
Township/Range/Section: T22N R22E, SEC31,
Local Directions: At Levy, 19 miles south of Springer, cross the railroad tracks to the east, and enter a yellow gate. (If this gate is locked, follow the railroad tracks to the north for about ¼ mile to another gate.) Turn north and follow the paved road for about ½ mile. Turn east and go towards a water tank that is visible about ½ mile east. Follow the road east from this tank to a second tank until a gate is reached. Go through the gate and follow the fence east to the two playas that are located here; this is the first playa encountered.

Water Features: The playa is split into eight areas of ponding. Six of these areas are shallow depressions that appear to be naturally formed, and two are excavated stock tanks. The excavated dirt surrounding the tanks are fully vegetated, indicating that the work was done some time ago.

pH = 9.39; specific conductance = 541 μmohs; salinity = 0 ppt.

Landscape Features: Gently sloping rolling hills surround the playa. This basin is drawn as a single feature on the topographical maps, but use and manipulation have apparently broken the basin up into smaller units. A fence runs through the north third of the playa, separating pastures.

Vegetation Description: We randomly chose two separate mini-basins in which to establish our transects: Transect A is in an excavated dugout, and Transect B in a more natural depression. Transect A progresses from relatively deep water in Zone 1 to a mix of the wetland obligate western waterclover (*Marsilea vestita*) and the facultative wetland species spreading yellowcress (*Rorippa sinuata*) in Zone 2. Zone 3 is a transitional community between wetlands and uplands and consists of buffalo grass (*Buchloe dactyloides*) and western wheatgrass (*Pascopyrum smithii*) in Zone 3. In contrast, Transect B is dominated by common spikerush (*Eleocharis palustris* spp.) with scattered Pennsylvania knotweed (*Polygonum pensylvanicum*), grading into a nearly pure stand of western wheatgrass on the playa banks (Zone 2), and then to an upland blue grama-buffalo grass community

Wildlife/Livestock: Antelope in vicinity, ducks (gadwalls?), American avocet and killdeer on and around water, and about 150 cows

Soils

Surrounding soils (Mora County Soil Survey): The surrounding soils are mostly Vermejo silty loams, with shale alluvium parent material. Fine, mixed (calcareous), mesic Ustic Torriorthents is the primary soil taxon.

Playa basin soils (sampled along Transect A):

Zone 1: Ustic Endoaquert

C1: 0-50cm; gray (2.5Y 5/1 ped/moist); clay (100% clay); massive, many medium, prominent orangish mottles. Soil cracks to 5cm wide.
Sample location: near water's edge and Station 2.

Zone 2: Ustic Endoaquert

C1: 0-37cm; black (10YR 5/1 ped/dry) to very dark gray (10YR 3/1 ped/moist); clay (90% clay); massive; few medium and few fine roots in upper 5 cm; common calcic nodules; common orangish mottles. Soil cracks to 5 cm wide.
Sample location: Station 3

Zone 3: Ustic Enodaquert/Torrertic Argiustoll

A1: 0-2cm; silty clay loam (clay 40%); medium platy; clear boundary.
C1: 2-35cm; gray (10YR 6/1 ped/dry); clay (clay 90%), dark gray (10YR4/1 rub/moist); massive; common calcic nodules.
Sample location: Between Stations 4 and 5

Zone 3: Argiustoll

A1: 0-4cm; dark grayish brown (10YR 4/2 ped/dry); loam (clay 25%) very dark grayish brown (10YR 3/2 rub/moist); fine subangular blocky; many fine roots; abrupt boundary.
C1: 4-35cm; grayish brown (10YR 5/2 ped/dry); sandy clay loam (35% clay), very dark grayish brown (10YR 3/2 rub moist); common calcic nodules.
Sample location: Between Stations 7 and 8, beyond vegetation transect in a blue grama- buffalo grass grassland

Average cover type values for Playa 2, Transect A

		Mean cover (%)		
Species Name	**Wetland Status**	**Zone 1**	**Zone 2**	**Zone 3**
Algae/Cyanobacteria		34.38		
Aristida divaricata				0.10
Astragalus spp.				10.06
Bare Soil		46.50	77.75	67.61
Buchloe dactyloides	FACU		1.67	6.55
Eleocharis palustris	FACW		2.62	0.05
Grindelia squarrosa	FACU			0.04
Iva axillaris	FAC		0.30	0.35
Litter		5.38	5.62	5.99
Marsilea vestita	OBL		7.48	0.01
Melilotus officinalis	FACU+			0.19
Pascopyrum smithii	FAC-		0.67	5.57
Polygonum spp.				0.11
Rock				0.01
Rorippa sinuata	FACW		3.72	1.55
Schedonnardus paniculatus				0.30
Verbena bracteata	FAC		0.17	1.75
Water		26.25		
# quadrats (n)		8	60	132

Average cover type values for Playa 2, Transect B

		Mean cover (%)		
Species Name	**Wetland Status**	**Zone 1**	**Zone 2**	**Zone 3**
Astragalus spp.			0.30	
Atriplex canescens	UPL			1.48
Bouteloua gracilis			0.90	50.74
Bare Soil		58.96	69.21	34.93
Buchloe dactyloides	FACU		3.98	6.11
Grindelia squarrosa	FACU		0.06	
Eleocharis palustris	FACW	38.44		
Iva axillaris	FAC	0.16	1.19	
Litter		0.28	2.35	6.67
Marsilea vestita	OBL		0.01	
Pascopyrum smithii	FAC-	0.60	20.66	3.41
Phyla nodiflora	FACW		0.07	
Polygonum pensylvanicum	OBL	1.56		
Sphaeralcea spp.			0.15	
Unidentified			0.41	0.37
# quadrats (n)		25	117	27

PLAYA 3

Sampled: October 14, 1998
Treatment: Modified
Estimated Size: 160 acres

Location

Quad Map: Abbott
County: Colfax
Elevation: 6,045 ft.
UTM's: N4019879, E558252
Lat/Long: 36.155, 104.3577
Township/Range/Section: T24N R24E, SEC 11, 12, 13, 14
Local Directions: Go about 11.5 to 12 miles east of Springer on Highway 56. Take County Road 44 north and follow it for about 2 miles – it proceeds first north, then east, north again and then east. At this corner, just before the road heads north again, go through a gate in the fence running along the road. Follow the faint two track heading south on the other side of the fence for about ½ mile. The playa is clearly visible over the crest of this hill.

Water Features: This is a large, deep playa that receives drainage from two other playas to the northwest through two other drainages. It has been excavated and dammed (on the southwest side) and probably has water for most of year.

pH = 8.95; specific conductance = 359 μmohs; salinity = 0 ppt.

Landscape Features: This is a large basin with very gentle slopes. The hydromodifications have been in place since before 1965, as the topographic map from that year shows the dam and the manmade channels diverting water from two other playas to the northwest.

Vegetation Description: Although there are small patches of wetland indicators near the water, upland vegetation begins almost immediately past a barren strip at water's edge. In both transects, Zone 1 nearest the water is a mix of wetland and upland species, with buffalo grass (*Buchloe dactyloides*), common spikerush (*Eleocharis palustris*), saltgrass (*Distichlis spicata*), spreading yellowcress (*Rorippa sinuata*) and western wheatgrass (*Pascopyrum smithii*) occurring in patches within 18m of each other. Zone 2 in both cases is dominated by buffalo grass with scattered blue grama, western wheatgrass or alkali sacaton mixed in. Zone 3 represents the uplands, and is composed mostly of blue grama and buffalo grass with the disturbance indicator snakeweed (*Gutierrezia sarothrae*) distributed liberally throughout.

Wildlife/Livestock: This playa attracts large numbers of migrating waterfowl birds. On the sampling date, we observed numerous coots, ducks and cattle egrets, an American

avocet, about 30 sandhill cranes and one blue heron.. Livestock use is obvious, and about 150 cattle were in the vicinity of the playa.

Soils

Surrounding soils (Colfax County Soil Survey): Colmor association, 0-9% slope/LaBrier silt loam, 0-2% slope. Parent material is shale alluvium and fine alluvium/eolian deposits. The predominant soil families are fine-silty, mixed, mesic Aridic Haplustolls and fine, mixed, mesic Torrertic Argiustolls.

Playa basin soil (sampled along Transect B):

Zone 1: Chromic Udic Haplusterts

C1: 0 to 40 cm; sandy clay (55% clay), light yellowish brown (10YR6/4 rub/moist); massive; common distinct black and orangish mottles.
Sampling location: In water, between Stations 1 and 2

Zone 1: Chromic Udic Haplustert (2nd sample)

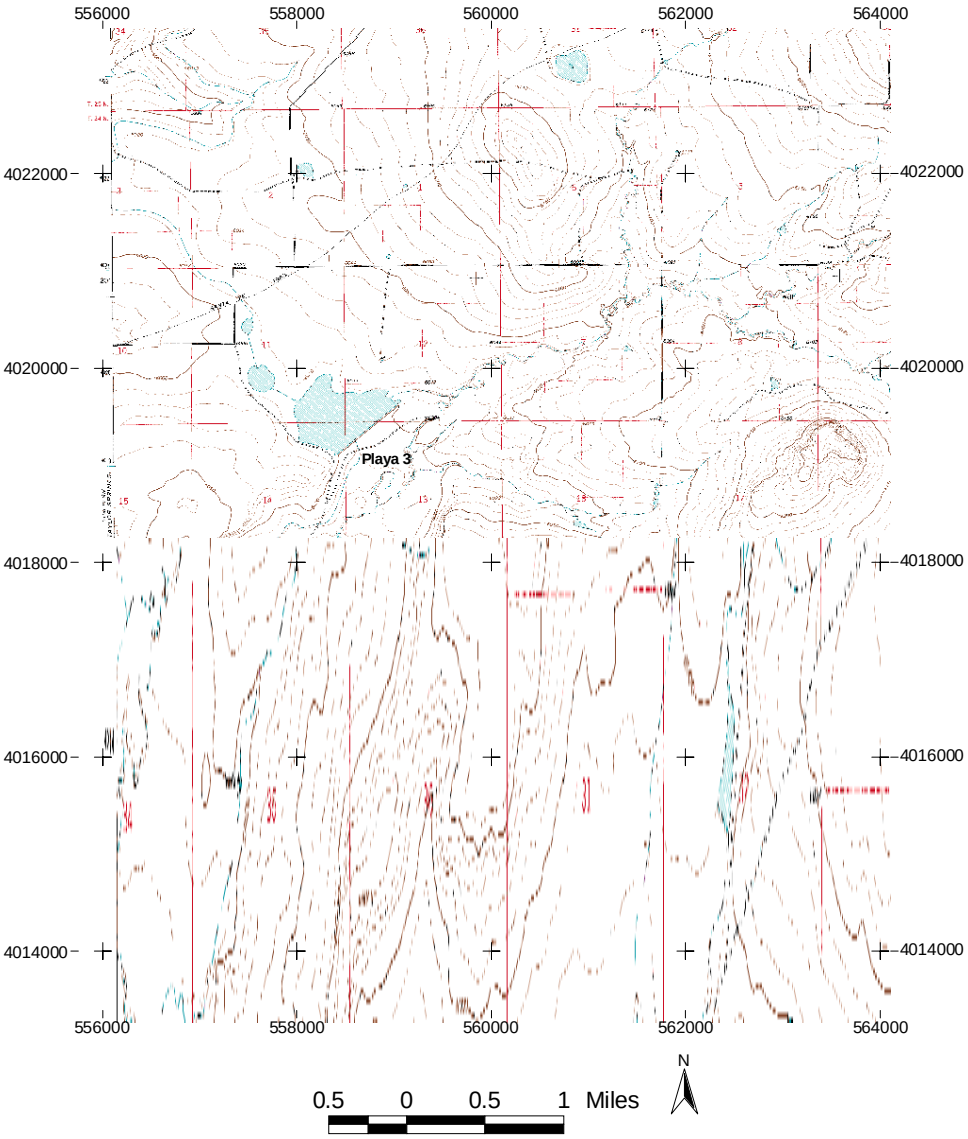
A1: 0 to 2 cm; light brownish gray (2.5Y 6/2 ped/dry); clay (90% clay), olive brown (2.5Y4/3 rub/moist); medium platy; common medium, common fine roots; clear boundary. Soil cracks to 1 cm deep.
C1: 2 to 46cm; sandy clay (55% clay), light yellowish brown (10YR 6/4 rub/moist); massive; common red and orangish mottles; few fine roots.
Sampling location: Station 2 at waters edge.

Zone 2: Chromic Udic Haplustert

A1: 0 to 2 cm; light yellowish brown (2.5Y 6/3 ped/dry); clay loam (clay 65%), light olive brown (2.5Y 5/3 rub/moist); medium platy; common fine roots.
C1: 2 to 46 cm; brown (10YR4/3 ped/dry); clay loam (clay 65%), brown (10YR 5/3 rub/moist); medium subangular blocky; few fine roots. Soil surface cracked to 1 cm deep
Sampling location: near Station 4.

Zone 3: probably Calcidic Argiustoll

A1: 0 to 10 cm; light olive brown (2.5Y 5/3 ped/dry); loam (clay 60%), dark grayish brown (10YR 4/2 rub/moist); medium subangular block; common medium and common fine roots; clear boundary.
Btk: 6-36 cm; brown (10YR 4/3 ped/dry); silty clay loam (clay 80%), brown (10YR 4/3 rub/moist); common calcic nodules; few fine roots.
Sampling location: Station 8



Location of Playa 3, Abbott Quadrangle

Average cover type values for Playa 3, Transect A

		Mean cover (%)		
Species Name	**Wetland Status**	**Zone 1**	**Zone 2**	**Zone 3**
Algae/Cyanobacteria		0.81		
Aristida divaricata	NI			0.53
Artemisia frigida	NI			0.09
Bare Soil		2.34	27.20	21.79
Bouteloua gracilis	NI		0.85	21.21
Buchloe dactyloides	FACU	15.16	38.59	27.24
Chaetopappa ericoides			0.05	
Cirsium spp.			0.18	0.38
Distichlis spicata	FACW			2.21
Eleocharis palustris	OBL	2.75		
Erigeron flagellaris	FAC-		1.97	2.68
Grindelia squarrosa	FACU			0.09
Gutierrezia sarothrae	NI		3.68	11.00
Iva axillaris	FAC		0.42	
Linum lewisii	NI		0.01	0.12
Litter		0.47	18.66	6.18
Muhlenbergia torreyi				0.44
Pascopyrum smithii	FAC-	0.78	2.23	0.09
Phyla nodiflora	FACW		0.18	0.29
Ratibida tagetes	NI		0.74	2.12
Rorippa sinuata	FACW		0.34	
Schedonnardus paniculatus	NI		0.53	2.21
Schoenoplectus tabernaemontani	OBL		0.41	
Sphaeralcea spp.				0.38
Sporobolus airoides	FAC		3.61	0.29
Verbena bracteata	FAC		0.24	
Water		77.69		
# quadrats (n):		32	74	34

Average cover type values for Playa 3, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Astragalus spp.			0.25	0.38
Bouteloua gracilis	NI		4.00	61.96
Bare Soil		29.97	17.00	21.13
Buchloe dactyloides	FACU	3.94	62.65	
Cirsium spp.				0.67
Distichlis spicata	FACW	2.17	0.95	2.58
Eleocharis palustris	OBL	1.69		0.13
Erigeron flagellaris	FAC-		0.50	0.29
Gutierrezia sarothrae	NI		0.80	4.67
Linum lewisii	NI	0.08		
Litter		5.53	6.20	3.04
Pascopyrum smithii	FAC-	4.28	2.05	0.13
Phyla nodiflora	FACW		0.40	0.17
Ratibida tagetes	NI		2.45	1.79
Rorippa sinuata	FACW	3.19	2.25	0.08
Schedonnardus paniculatus	NI			0.21
Water		49.06		
# quadrats (n)		36	20	24

PLAYA 4

Sampled: October 4, 1998
Treatment: Natural
Estimated Size: 7.6 acres

Location

Quad Map: Abbot Lake
County: Colfax
Elevation: 5854' (1784m)
UTM's: N4009252, E565674
Lat/Long: 35.2245º, 104.2683º
Township/Range/Section: T23N, R25E, Sec. 15
Local Directions: Head east from Springer about 21 miles to the intersection with State Road 39; turn south here for 6 miles. Go through gate on the west side of the road; head northwest over the plains for just over ½ mile. The playa is small and can't be seen until you are pretty close to it.

Water Features: This is a shallow, non-saline pool in an unmodified playa. Area of inundation fairly small, area of recharge larger.

pH = 8.96; specific conductance = 324 μmohs; salinty = 0 ppt.

Landscape Features: This is a nearly symmetrical basin with some cutting along the east bank. The basin substrate very clayey. This playa is largely undisturbed, but the surrounding area is grazed.

Vegetation Description: The center of the playa (Zone 1) is strongly dominated by the obligate wetland species Pennsylvania knotweed (*Polygonum pensylvanicum*) with a wee scattering of spreading yellowcress (*Rorippa sinuata*). Spreading yellowcress increases away from standing water to dominate the vegetation of Zone 2, with buffalo grass (*Buchloe dactyloides*), western wheatgrass (*Pascopyrum smithii*), spiny dogweed (*Thymophylla acerosa*), locoweed (*Astragalus* spp.), and big bract verbena (*Verbena bracteata*) mixed in at much lower quantities. Further upslope in Zone 3, buffalo grass and western wheatgrass form a grassland with some forbs sprinkled in. Zones 2 and 3 were not at all distinct in the field, and only became apparent with analysis. The buffalo grass/sand muhly (*Muhlenbergia arenicola*) grass of Zone 4 (Transect B only) are indicative of a drier environment.

Wildlife Notes: Pronghorn and small passerine birds were seen in the vicinity, but no water fowl.

Soils

Surrounding soils (ColfaxCounty Soil Survey): Surrounding soils are fine-silty, mixed, mesic Aridic Haplustolls derived from shale alluvium and are of the Colmor association.

Playa basin soil (sampled along Transect B):

Zone 1: Ustic Endoaquert

C1: 0 to 50 cm; grayish brown (10YR 5/2 ped/moist); clayey (95% clay); few medium roots.

Sampling location: Station 2

Zone 2: Ustic Endoaquert

A1: 0 to 4 cm; gray (10YR 5/1 ped/moist); clay loam (40% clay), dark gray (10YR 4/1 crush/dry); fine subangular blocky; few fine foots; traces of gravel; clear boundary; surface cracking present.

Sampling location: Station 3

Zone 4 (1st sample): Typic Argiustoll

A1: 0 to 2 cm; sandy loam, dark grayish brown (10YR 4/2 rub/moist) to grayish brown (10YR 5/2 crush/dry)**;** very fine granular; many fine roots; few gravels; distinct boundary.

Bt1: 2 to 37 cm; sandy clay loam, brown (10YR 4/3 rub/moist) to dark grayish brown (10YR 4/2 crush/dry); coarse subangular blocky; few fine roots.

Sampling location: Station 6

Zone 4 (2nd sample): Typic Argiustoll

A1: 0 to 15 cm; sandy clay loam, very dark grayish brown (10YR 3/2 rub/moist) to dark grayish brown (10YR 4/2 crush/dry); medium subangular blocky; many fine roots; wavy boundary.

Bt1: 15 to 40 cm; clay loam, brown (10YR 4/3 rub/moist) to dark grayish brown (10YR 4/2 crush/dry); coarse subangular blocky; common fine roots.

Sampling location: Station 8

Location of Playa 4, Abbott Lake Quadrangle

Average cover type values for Playa 4, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria		0.12	1.39	
Astragalus spp.			1.58	3.05
Bare Soil			48.57	41.49
Buchloe dactyloides	FACU		4.17	16.05
Cuscuta cuspidata	NI			0.37
Gutierrezia sarothrae	NI			0.24
Litter		0.68	6.95	1.98
Melilotus officinalis	FACU+		0.04	
Pascopyrum smithii	FAC-		0.95	33.44
Phyla nodiflora	FACW		0.09	
Polygonum pensylvanicum	OBL	34.20	0.13	
Rock			0.06	
Rorippa sinuata	FACW	0.20	20.88	1.37
Schedonnardus paniculatus	NI		0.04	
Tetraclea coulteri				0.07
Thymophylla acerosa	NI		3.89	1.95
Unidentified forb			0.13	
Verbena bracteata	FAC		1.05	
Water		64.80	10.08	
# quadrats (n)		41	117	41

Average cover type values for Playa 4, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3	Zone 4
Algae/Cyanobacteria		0.46			
Aristida divaricata	NI				0.49
Astragalus spp.				0.83	0.03
Bare Soil			63.55	61.04	45.93
Buchloe dactyloides	FACU			10.92	36.25
Bouteloua gracilis	NI				1.62
Cuscuta spp.	NI		0.02		
Echinochloa crus-galli	FACW-			0.08	
Eleocharis spp.			0.24		
Hedeoma drummondii				0.02	
Iva axillaris	FAC				0.41
Litter		2.10	3.00	4.54	1.90
Muhlenbergia arenicola					8.43
Pascopyrum smithii	FAC-		4.83	0.38	1.13
Polygonum pensylvanicum	OBL	25.65	0.36		
Phyla nodiflora	FACW			1.13	2.84
Rock			0.05	0.83	0.02
Rorippa sinuata	FACW	0.10	15.76	0.88	
Schedonnardus paniculatus	NI			0.83	0.74
Sphaeralcea coccinea	NI				0.05
Thymophylla acerosa	NI		6.33	18.25	0.11
Verbena bracteata	FAC		0.36	0.27	
Water		71.69	5.50		
# quadrats (n)		48	42	48	61

PLAYA 5

Sampled: October 5, 1998
Treatment: Modified
Estimated Size: 6.8 acres

Location

Quad Map: Mills East
County: Harding
Elevation: 6,178 feet
UTM's: N3997357, E568191
Lat/Long: 36.1223, 104.2504
Township/Range/Section: T22N, R25E, Sec. 23
Local Directions: Head east from Springer about 21 miles to the intersection with SR 39; turn south here for 13 miles. Turn east onto dirt road; after 1 mile turn north and go through gate.

Water Features: Large basin, but the zone of inundation is relatively small. Water depth is about ¾ meter.

pH = 8.84; specific conductance = 309 μmohs; salinity = 0 ppt.

Landscape Features: This playa has been extensively modified so that there one part of the basin maintains fairly natural features, and is fenced off from a separate stock tank to the south.

Vegetation Description: The vegetation of Zone 1 at the center of the playa differs greatly between the two transects. Transect A has a wide mix of species dominated by western wheatgrass (*Pascopyrum smithii*), with a fair amount of spiny dogweed (*Thymophylla acerosa*) and spreading yellowcress (*Rorippa sinuata*) mixed in. Transect B, however, has far fewer species in Zone 1 and is co-dominated by wetland indicators spikerush (*Eleocharis* spp.) and Pennsylvania knotweed. Zone 2 in both cases is a mix of buffalo grass (*Buchloe dactyloides*) with western wheatgrass (*Pascopyrum smithii*), but buffalo grass dominates in Transect A and western wheatgrass dominates Transect B. Further upslope in Zone 3, buffalo grass increases, with western wheatgrass and frogfruit (*Phyla nodiflora*) occurring in Transect B, whereas walkingstick grass (*Schedonnardus paniculatus*) and snakeweed (*Gutierrezia sarothrae*) reflect the drier gradient present along Transect A.

Wildlife Notes: Salamanders, 'boatmen', scavenger beetles in the benthic sweep.

Soils

Surrounding soils (Harding County Soil Survey):
The surrounding area is composed of fine-loamy, mixed, mesic Typic Calciustolls derived from calcareous alluvium and eolian deposits of the Campus loam (3-9% slopes) soil series.

Playa basin soil (sampled along Transect A):

Zone 1: Ustic Endoaquert

C1: 0 to 40 cm; sandy clay (55% clay); dark gray (10YR 4/1 rub/moist); coarse subangular blocky; few medium roots.

Sampling location: In saturated clay at water's edge, Station 2

Zone 2: Ustic Endoaquert

A1: 0 to 2 cm; gray (10YR 5/1 ped/dry); clay loam (40% clay), very dark gray (10YR 3/1 rub/moist); medium platy; few fine and medium roots, clear boundary.

C1: 2 to 45 cm; very dark gray (10YR 3/1 ped/dry); clay loam (40% clay), dark grayish brown (10YR 4/2 rub/moist); coarse subangular blocky; few fine roots. Cracking on surface.

Sampling location: Between Stations 3 and 4.

Beyond Zone 3: Lithic Argiustoll

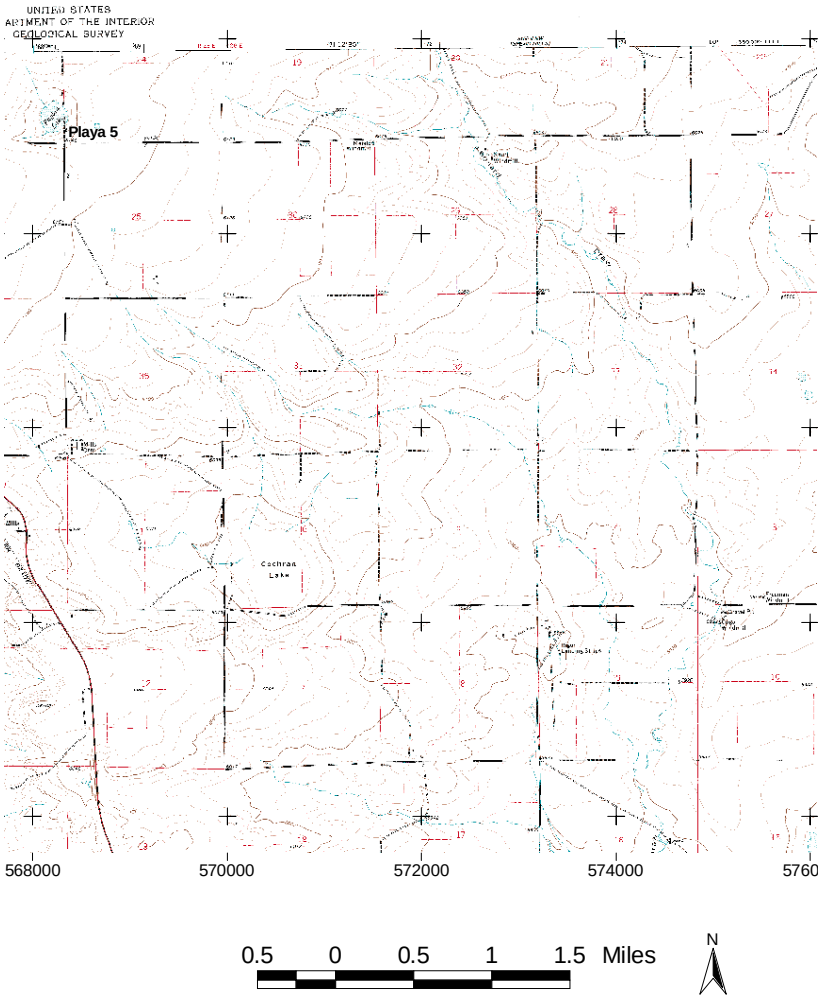
A1: 0 to 2 cm; brown (10YR 4/3 ped/dry); sandy loam (clay 20%), dark brown (10YR 3/3 rub/moist); fine granular; many fine roots; abrupt boundary.

Bt1: 2 to 15 cm; dark brown (10YR 3/3 ped/dry); sandy clay loam (clay 35%), brown (10YR 4/3 rub/moist); medium subangular blocky; common reddish mottles, few calcic fragments; many fine roots; clear boundary.

Bt2: 15 to 27cm; brown (10YR 4/3 ped/dry); sandy clay loam (clay 35%), brown (10YR 5/3 rub/moist); medium subangular blocky; common calcic fragments; few fine roots; abrupt boundary.

Bk: 27cm +; very pale brown (10YR 8/2 ped/dry); massive; very hard (dry).

Sampling location: Station 7 near base of playa slope.



Location of Playa 5, Mills East Quadrangle

Average cover type values for Playa 5, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Amaranthus spp.		0.01		
Bare Soil		58.71	32.31	30.84
Buchloe dactyloides	FACU	1.80	51.62	55.66
Bouteloua gracilis			0.88	3.28
Dyssodia papposa		3.89	4.85	1.75
Eleocharis spp.	OBL	1.92		
Euphorbia marginata	FACU	0.01		
Grindelia squarrosa	FACU		0.04	
Gutierrezia sarothrae			0.08	0.50
Hedeoma drummondii		0.02	0.00	
Litter		2.74	2.73	2.88
Melilotus officinalis	FACU+	0.23	0.23	
Opuntia spp.				0.31
Pascopyrum smithii	FAC-	10.43	3.88	0.91
Phyla nodiflora	FACW	0.04	0.85	
Polygonum pensylvanicum	OBL	0.46		
Rock		0.07		0.38
Rorippa sinuata	FACW	3.82		
Schedonnardus paniculatus	NI	0.13	2.38	3.47
Verbena bracteata	FAC	0.06		
Water		15.66		
# quadrats (n)	200	142	26	32

Average cover type values for Playa 5, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria		0.59		
Amaranthus spp.			0.07	0.05
Bare Soil		9.56	75.65	49.53
Buchloe dactyloides	FACU		2.67	38.53
Chamaesyce spp.			0.09	
Dyssodia papposa			0.72	
Echinochloa crus-galli	FACW-	0.78		
Eleocharis spp.		3.44		
Hedeoma drummondii			0.10	
Iva axillaris	FAC		0.02	0.26
Litter		0.15	2.38	3.47
Pascopyrum smithii	FAC-	0.44	15.83	4.58
Phyla nodiflora	FACW		0.72	2.11
Polygonum pensylvanicum	OBL	1.85		
Ratibida tagetes	NI		0.01	0.21
Rock			0.02	
Rorippa sinuata	FACW	0.56	1.51	
Schedonnardus paniculatus	NI		0.06	
Sphaeralcea coccinea	NI			1.05
Verbena bracteata	FAC		0.03	0.21
Water		82.63		
# quadrats (n)		27	156	19

PLAYA 6

Sampled: October 16, 1998
Treatment: Natural
Estimated Size: 8.4 acres

Location

Quad Map: Mills East
County: Harding
Elevation: 5,881 feet
UTM's: N3985727 E568191
Lat/Long: 36.1223, 104.2504
Township/Range/Section: T22N R25E, Sec. 23
Local Directions: Head east from Springer 21 miles to the intersection with State Road 39; turn south here for 21 miles. Turn west on county road for four miles. Just after mile four, the road takes a jog to the south, but immediately heads west again. After one mile, go through a gate (usually locked, phone contact); playa is just beyond fence paralleling road to north. To get through this fence, travel for about 1/3 mile to another gate on the north side of the road. Go through this and backtrack to playa. Contact is Keith Scott of Roy, NM.

Water Features: Water is clear and deeper on west side (about1m) than on the east side (1/3 m).

pH = 8.29; specific conductance = 248 μmohs; salinity = 0 ppt.

Landscape Features: The playa basin is dissected by an island peninsula from the north which may be old earthwork.

Vegetation Description: Both transects start on the island, dip down into water, and end on the far bank, but not quite out of the playa basin. Zone 1 of both transects is characterized by relatively high cover of western wheatgrass (*Pascopyrum smithii*) with smaller amounts of buffalo grass (*Buchloe dactyloides*) and frogfruit (*Phyla nodiflora*), along in association with common spikerush (*Eleocharis palustris*) in Transect A. Zone 2 consists of shallow water with common spikerush and western wheatgrass in Transect A, but plants are mostly submerged or absent in Transect B. Zone 3 is characterized by buffalo grass with a western wheatgrass sub-dominant, and various upland and wetland forbs mixed in.

Wildlife Notes: One sandhill crane, a few mallards, several coots, a harrier and a redtail hawk were noted.

Soils

Surrounding soils (Harding County Soil Survey): The surrounding soils are mostly fine, mixed, mesic Aquic Camborthids derived from clayey, calcareous, alkaline water-laid sediments of the Church clay loam series (0-2% slope).

Playa basin soil (sampled along Transect B):

Zone 1: Ustic Endoaquert

A1: 0 to 5 cm; gray (10YR 6/1 ped/dry) to very dark grayish brown (10YR 3/2 ped/moist); sandy clay loam (clay 35%); coarse platy; common medium roots; clear boundary.

C1: 5 to 32 cm; very dark grayish brown (ped/moist); clayey (clay 90%); massive; few fine roots; common orangish mottles. Soil moist at 1 cm and cracks on surface to 1 cm deep.

Sampling location: Station 1 on island peninsula

Zone 2: Calciustert/Haplustert

A1: 0 to 5 cm; light gray (10YR 7/2 ped/dry); silty clay loam (clay 40%), brown (10YR 4/3 rub/moist), medium platy; few medium roots; clear boundary.

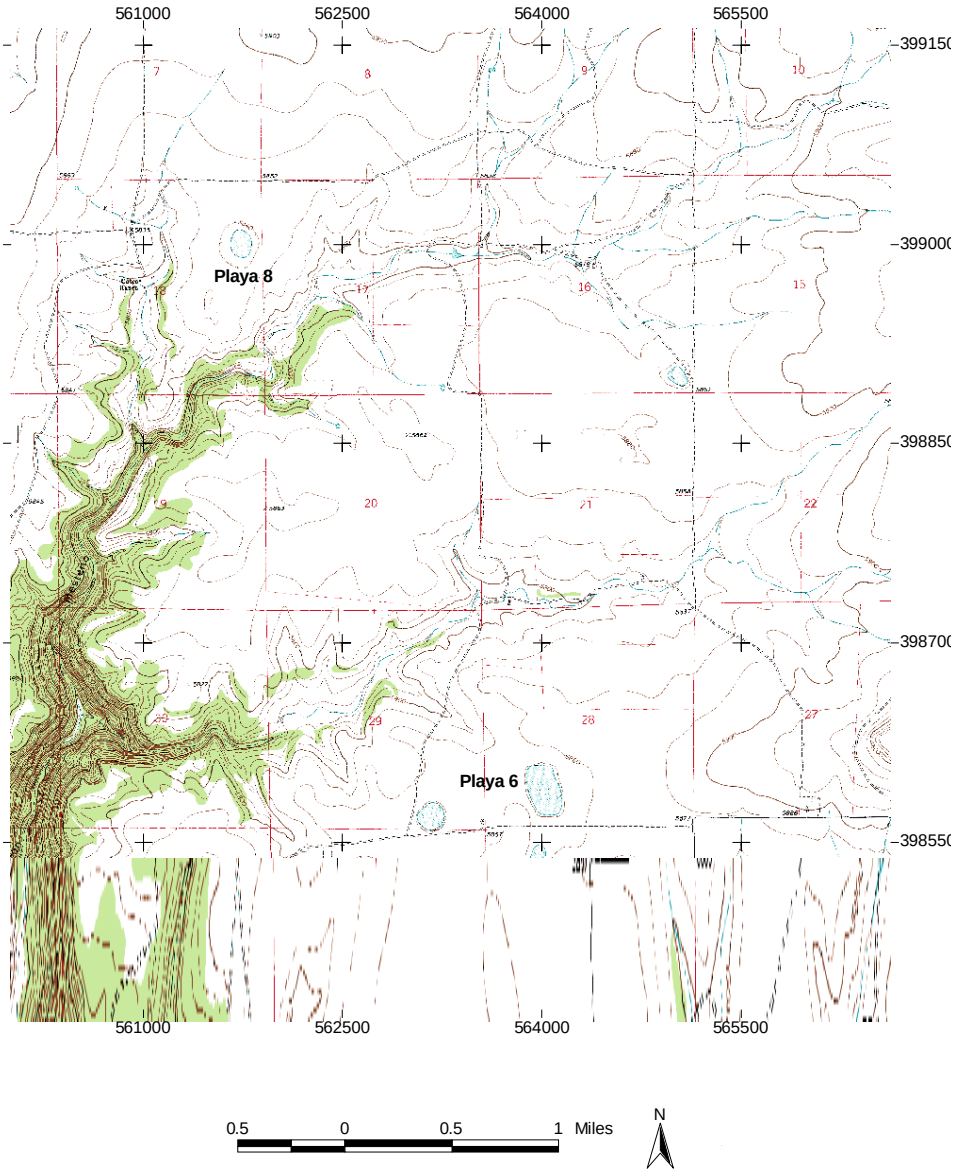
C1: 5 to 36 cm; clayey (clay 90%), yellowish brown (10YR 5/4 rub/moist); few orangish mottles massive; few calcic nodules; few fine roots. Soil moist at 1 cm and cracks on surface to 3mm deep.

Sampling location: Between Stations 4 and 5 at the far edge of the water.

Zone 3: Calciustert/Haplustert

A1: 0 to 5 cm; very dark grayish brown (10YR 3/2 ped/dry); loam (clay 25%), dark grayish brown (10YR 4/2 rub/moist); common orangish mottles; medium subangular blocky; many fine roots; clear boundary.

C1: 5 to 35 cm; brown (10YR 4/3 ped/dry); sandy clay loam (clay 35%); yellowish brown (10YR 5/4 rub/moist); common calcic nodules; coarse subangular blocky; few fine roots.



Location of Playas 6 and 8, Mills East Quadrangle

Average cover type values for Playa 6, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria		2.42	0.59	
Astragalus spp.				0.60
Bare Soil		20.21	10.68	36.50
Buchloe dactyloides	FACU	2.14	0.24	20.40
Eleocharis palustris	OBL	3.63	6.05	
Grindelia squarrosa	FACU			0.74
Iva axillaris	FAC		0.34	4.34
Litter		14.56	0.93	3.64
Pascopyrum smithii	FAC-	7.16	4.85	32.49
Phyla nodiflora	FACW	2.14	0.25	0.80
Rock		0.23		
Ratibida tagetes	NI			0.14
Schedonnardus paniculatus	NI			0.14
Scirpus spp.		0.81	0.20	0.14
Vicia americana	FACU			0.06
Water		46.93	75.87	
# quadrats (n)		43	147	70

Average cover type values for Playa 6, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria		4.25	5.28	
Bare Soil		51.35	10.61	4.40
Buchloe dactyloides	FACU	3.93	1.32	77.88
Eleocharis palustris	OBL	0.08	0.21	
Grindelia squarrosa	FACU	0.45		4.02
Gutierrezia sarothrae	NI			0.51
Iva axillaris	FAC		0.03	0.72
Linum lewisii	NI			0.02
Litter		3.40	3.17	2.67
Pascopyrum smithii	FAC-	34.53	1.68	7.81
Phyla nodiflora	FACW	1.15	0.21	1.07
Ratibida tagetes	NI	0.13		0.84
Rock				0.05
Schedonnardus paniculatus	NI	0.20		
Scirpus spp.		0.38	0.03	
Verbena bracteata	FAC	0.18		
Water			77.47	
# quadrats (n)		40	117	43

PLAYA 7

Sampled: October 2, 1998
Treatment: Natural
Estimated Size: 4.5 acres

Location

Quad Map: Point of Rocks
County: Colfax
Elevation: 6,807 feet
UTM's: N4029625 E572771
Lat/Long: 36.4170, 104.1966
Township/Range/Section: T25N R26E, Sec. 8
Local Directions: Head east from Springer for 25 miles to the Point of Rocks/Dorsey Mansion turnoff. Head north on this road for just over 7 miles; the playa is accessible through the fence to the west, but there is no gate here. Contact is Pete Gaines who lives just to the north of this playa in a trailer.

Water Features: At time of sampling, the playa was dry, but Mr. Gaines indicated it was wet earlier this year. It had also been dammed in the 1950's, but the present leasee removed the structure some years ago.

pH 7.51; specific conductance 77 μmohs; salinity 0 ppt.

Landscape Features: There is some erosion on the north bank and around the playa edge and dam remnants near the east end. This is a very gently sloping playa. Two other, similar playas are about ¾ mile to the west, and it is likely that these three playas were important water sources to travelers along the Santa Fe Trail, which runs just to the north.

Vegetation Description: Zone 1 of both transects consists of a small, sparsely populated community of spreading yellowcress (*Rorippa sinuata*) and Pennsylvania knotweed (*Polygonum pensylvanicum*). Spreading yellowcress is a strong dominant of Zone 2, nearly to the exclusion of other species in Transect B, but with a sizable amount of scattered big-bract verbena (*Verbena bracteata*) and sweetclover (*Melilotus officinalis*) in Transect A. Zone 3 is a blue grama (*Bouteloua gracilis*)/walking stick (*Schedonnardus paniculatus*) upland grass community in Transect A with scattered forbs indicative of both wetlands and uplands. Zone 3 of Transect B, however, is lower in the playa basin and shows more of an influence from an enhanced moisture regime. Spreading yellowcress is at significantly lower cover than in Zone 2, but still dominates. Sweetclover and buffalo grass increase somewhat, but overall, vegetation in this zone is relatively sparse. Zone 4 of Transect B is on the playa slope, and is the familiar blue grama-buffalograss (*Buchloe dactyloides)* grassland community of this region.

Wildlife Notes: There is an extensive prairie dog town that stretches for at least a mile to the west that was closely monitored by at least two Swainson's hawks while we were here. Pronghorn are also present, and we heard migrating sandhill cranes.

Soils

Surrounding soils (Colfax County Soil Survey): Surrounding soils are fine, mixed, mesic Aridic Paleustolls derived from eolian deposits and are of the Gruver loam series (0-3% slope).

Playa basin soil (sampled along Transect B):

Zone 1: Ustic Endoaquert

A1: 0 to 2 cm; light brownish gray, silty clay loam (clay 40%), dark gray (10YR 4/1 rub/moist); medium platy; few medium roots; clear boundary.
C1: 2 to 30 cm; clay (95%), very dark grayish brown (10YR 3/2 rub/moist); massive.
Moist at 9cm. Surface soil cracks 2-3 cm deep. Lots of chert on surface (perhaps washed down from Point of Rocks Mesa to the northeast)
Sampling location: On playa bottom near the center

Zone 2: Ustic Endoaquert

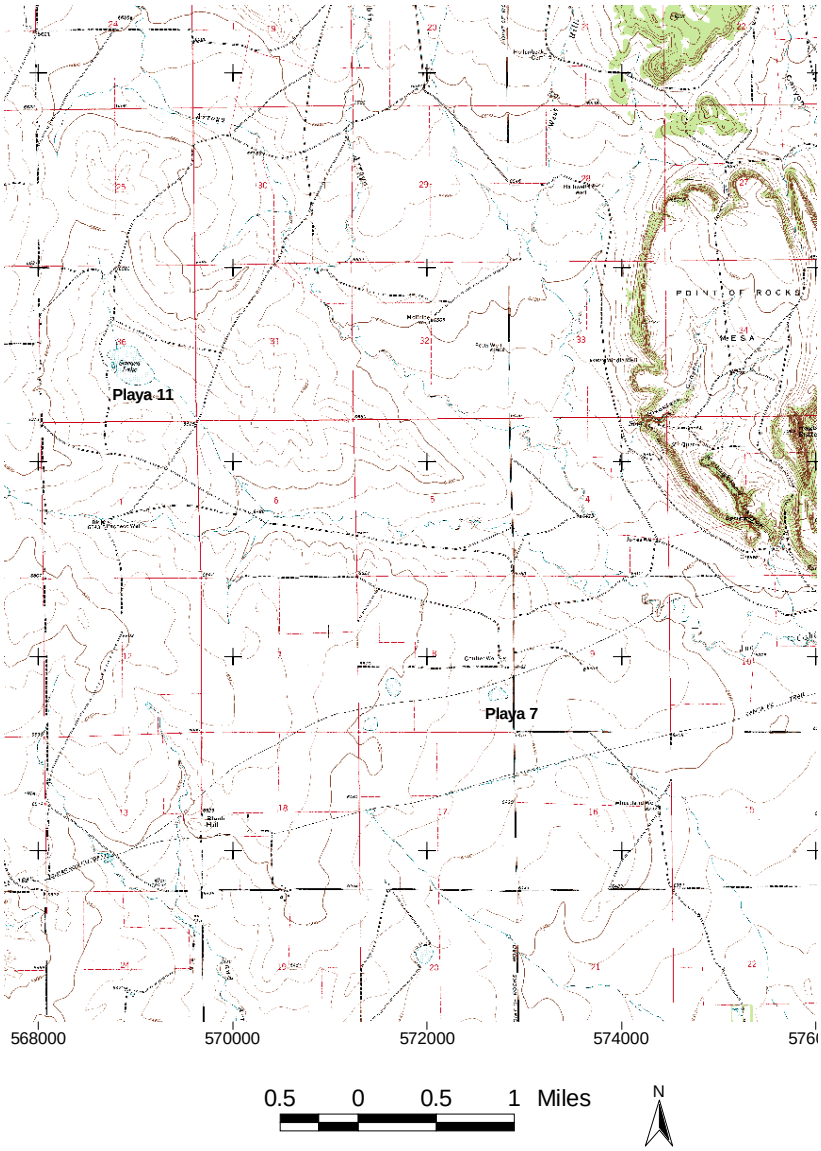
A1: 0 to 2 cm; light brownish gray (10YR 6/2 ped/dry); silty clay loam (clay 40%), dark gray (10YR 4/1 rub/moist); coarse platy; clear boundary.
C1: 2 to 30 cm; clay (95%), dark grayish brown (10YR 4/2 rub/moist); many red mottles; massive.
Moist at 5 cm. Surface soil cracks 2-4 cm deep.
Sampling location: Playa basin bottom near edge

Zone 3: prob. Haplustert

A1: 0 to 2 cm; pale yellow (2.5Y 7/3 ped/dry); sandy clay loam (clay 35%), dark grayish brown (10YR 4/2 rub/moist); medium platy; common fine; abrupt boundary.
C1: 2 to 30 cm; very pale brown (10YR 7/3 ped/dry); silty clay loam (clay 40%), light yellowish brown (10YR 6/4 rub/moist); medium/coarse subangular blocky; few orangish mottles; few calcic nodules; few fine roots.
Surface soil cracks to 1 cm deep.
Sampling location: Gentle playa slope

Zone 4: prob. Haplustert

A1: 0 to 2 cm; light gray (2.5Y 7/2 ped/dry); silty clay loam (clay 40%), dark grayish brown (2.5Y 4/2 rub/moist); medium platy; common fine and common medium roots; clear boundary.
C1: 2 to 30cm; clay (95%), brown (10YR 4/3 rub/moist); medium subangular blocky; common fine roots.
Surface soil cracks to 2cm deep.
Sampling location: Upland flat dominated by blue grama (*Bouteloua gracilis*).



Location of Playas 7 and 11, Point of Rocks Quadrangle

Average cover type values for Playa 7, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Artemisia frigida	NI			0.46
Astragalus spp.				2.31
Bare Soil		95.00	56.36	31.31
Bouteloua gracilis	NI			9.69
Buchloe dactyloides	FACU		1.40	0.62
Cuscuta cuspidata	NI		0.06	
Dyssodia papposa			0.09	2.62
Echinochloa crus-galli	FACW-		0.09	
Elymus elymoides	UPL			0.38
Grindelia squarrosa	FACU		0.24	
Hymenopappus filifolius	NI			0.08
Iva axillaris	FAC			4.46
Litter		0.87	10.53	24.31
Melilotus officinalis	FACU+		3.91	0.23
Pascopyrum smithii	FAC-		0.06	0.38
Phyla nodiflora	FACW		0.07	6.31
Polygonum pensylvanicum	OBL	1.65	0.70	
Rorippa sinuata	FACW	2.48		
Bare Soil				
Rock			1.10	0.54
Rorippa sinuata	FACW		18.36	1.23
Schedonnardus paniculatus	NI		0.33	10.62
Thelesperma megapotamicum	NI			0.62
Verbena bracteata	FAC		4.90	2.15
# quadrats (n)		23	71	13

Average cover type values for Playa 7, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3	Zone 4
Artemisia frigida	NI				0.11
Bare Soil		94.09	67.83	77.81	53.79
Bouteloua barbata	NI		0.01		
Bouteloua gracilis	NI				18.21
Buchloe dactyloides	FACU		0.37	1.75	10.75
Chamaesyce spp.				0.03	
Cuscuta cuspidata	NI		0.03	0.12	
Dyssodia papposa				1.07	0.50
Echinochloa crus-galli	FACW-		0.10	0.02	
Eleocharis spp.			0.83	0.02	
Grindelia squarrosa	FACU		0.11	0.25	0.18
Gutierrezia sarothrae	NI				0.18
Iva axillaris	FAC			0.02	0.82
Litter		0.23	1.79	4.34	8.89
Melilotus officinalis	FACU+		0.40	3.46	0.43
Pascopyrum smithii	FAC-			0.08	
Phyla nodiflora	FACW				1.86
Polygonum pensylvanicum	OBL	2.18	0.31		
Rock			1.55	1.29	0.04
Rorippa sinuata	FACW	3.50	25.21	8.93	2.18
Schedonnardus paniculatus	NI		0.92	0.05	0.25
Solanum rostratum	NI			0.02	0.11
Verbena bracteata	FAC		0.08	0.15	0.18
# quadrats (n)		22	89	59	28

PLAYA 8

Sampled: October 6, 1998
Treatment: Natural
Estimated Size: 5.6 acres

Location

Quad Map: Mills West
County: Harding
Elevation: 5,881 feet
UTM's: N3990023 E561762
Lat/Long: 36.0493, 104.3220
Township/Range/Section: T21N R25E, Sec. 18
Local Directions: Head east from Springer 21 miles to intersection with State Road 38; turn south here for 26 miles to the Mills Canyon turnoff to the west. Follow this road for about 4.5 miles; turn south on a well-traveled road. Go about one mile and make a nearly 180º turn onto a faint rocky two-track road. Follow this road for about ½ mile – the playa is to the north of the road (although the topo map shows it to the south).

Water Features: This is a natural playa, not deepened, with about 1/4 m water in the bottom (it rained 5 days ago). The area of apparent regular inundation is small.

pH = 8.98; specific conductance = 76 μmohs; salinity = 0 ppt.

Landscape Features: Rolling grasslands still dominate the landscape, but they are increasingly interrupted by rocky drainages associated with the Canadian River to the west.

Vegetation Description: Zone 1 of both transects is characterized by dominance of spikerush (*Eleocharis* spp.) with cover of this species about four times higher along Transect B. Spreading yellowcress (*Rorippa sinuata*) and Pennsylvania knotweed (*Polygonum pensylvanicum*) are conspicuously present in this zone, but at low cover. In Transect A, vegetation progresses quickly to an upland type, with buffalo grass (*Buchloe dactyloides*) strongly dominating Zone 2 alongside a western wheatgrass subdominant. Gumweed (*Grindelia squarrosa*), frogfruit (*Phyla nodiflora*) and prairie coneflower (*Ratibida tagetes*) are also present in this zone. Zone 3 is composed almost entirely of upland species, particularly blue grama (*Bouteloua gracilis*) and poverty three-awn (*Aristida divaricata*). In contrast, Zones 2 and 3 of Transect B are only weakly differentiated, and are indicative of a prolonged intermediate zone between wetland and upland. These zones are both dominated by buffalo grass and western wheatgrass, with lesser amounts of spikerush. However, in Zone 3, the cover of wetland indicators western wheatgrass, spikerush and frogfruit drops substantially.

Wildlife Notes: One unidentified hawk, grasshoppers, and pronghorn.

Soils

Surrounding soils (Harding County Soil Survey): The surrounding soils are loamy, mixed, calcareous, mesic Lithic Ustic Torriorthents derived from eolian deposits and are of the Travessilla stony loam/Carnero complex.

Playa basin soil (sampled along Transect A):

Zone 1 (1st sample): Ustic Endoaquert

A1: 0 to 2 cm; dark gray (10YR 4/1 ped/dry) to very dark gray (2.5Y 3/1 ped/moist); clay (75%); coarse platy; very few medium roots; clear boundary.
C1: 2 to 38 cm; clay (90%), very dark gray (2.5Y 3/1 rub/moist); massive; very few medium roots.
Many surface soil cracks.
Sampling location: Between Stations 2 and 3

Zone 1 (2nd sample): Ustic Endoaquert

A1: 0 to 4 cm; dark grayish brown (10YR 4/2 ped/dry); clay loam (clay 40%), very dark gray (2.5Y 3/1 rub/moist); medium platy; common fine, common medium roots; clear boundary.
C1: 4 to 30 cm; very dark gray (10YR 3/1 ped/dry); clay (clay 75%), medium subangular blocky; few fine roots; common calcic nodules.
Many surface soil cracks.
Sampling location: Between Stations 3 and 4.

Zone 2: Ustic Endoaquert

A1: 0 to 1cm; dark gray (10YR 4/1 ped/dry); clay loam (clay 40%), very dark gray (10YR 3/1 rub/moist); fine platy/granular; common fine roots; clear boundary.
C1: 1 to 43 cm; very dark grayish brown (10YR 3/2 ped/dry); clay loam (clay 40%), very dark grayish brown (10YR 3/2 rub/moist); medium subangular blocky; few fine roots; common coarse calcic nodules. Little surface cracking.
Sampling location: Station 5

Zone 3: Ustic Torriorthent

A1: 0 to 6 cm; dark brown (10YR 3/3 ped/dry); loam (clay 27%), dark grayish brown (10YR 4/2 rub/moist); medium granular; common fine, common medium roots; clear boundary.
Bt1: 6 to 21 cm; dark yellowish brown (10YR 3/4 ped/dry); clay loam (clay 40%), dark grayish brown (10YR 4/2 rub/moist); medium subangular blocky; few medium roots; gradual boundary.
C1: 21 to 45+cm; brown (10YR 4/3 ped/dry); sandy clay loam (clay 35%), dark brown (10YR 3/3 rub/moist); medium subangular blocky; few fine roots; few calcic nodules. Little surface cracking.
Sampling location: Station 9

Average cover type values for Playa 8, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Aristida divaricata	NI		0.36	20.86
Artemisia frigida	NI			2.00
Bare Soil		31.00	29.46	24.95
Berlandiera lyrata				0.68
Bouteloua gracilis	NI		0.34	26.50
Buchloe dactyloides	FACU		35.02	0.18
Chaetopappa ericoides				0.59
Eleocharis spp.		7.36	0.06	
Erigeron flagellaris	FAC-		0.17	0.18
Grindelia squarrosa	FACU		2.56	
Gutierrezia sarothrae	NI		0.14	0.63
Iva axillaris	FAC	0.28	0.39	0.02
Linum lewisii	NI			0.30
Litter		3.14	19.56	15.23
Lycurus phleoides	NI			2.41
Oxytropis spp				0.09
Pascopyrum smithii	FAC-	0.36	7.16	0.55
Phyla nodiflora	FACW	0.83	1.94	
Polygonum pensylvanicum	OBL	1.61		
Ratibida tagetes	NI		2.09	1.20
Rorippa sinuata	FACW	3.81		
Schedonnardus paniculatus	NI		0.31	
Senecio multicapitatus	NI			0.04
Sphaeralcea spp.			0.02	2.63
Thelesperma megapotamicum	NI			0.23
Unidentified forb			0.04	
Unidentified forb				0.13
Verbena bracteata	FAC			0.04
Water		51.61		
# quadrats (n)				56

Average cover type values for Playa 8, Transect B

Species Name	Wetland Status	*Mean cover (%)* Zone 1	Zone 2	Zone 3
Aristida divaricata	NI			1.85
Bare Soil		43.37	42.50	22.63
Bouteloua gracilis	NI			0.02
Buchloe dactyloides	FACU		18.96	39.18
Eleocharis spp.		26.57	9.13	2.68
Grindelia squarrosa	FACU		0.29	2.78
Litter		0.66	4.25	15.69
Pascopyrum smithii	FAC-	0.63	22.25	12.24
Phyla nodiflora	FACW		2.54	0.54
Polygonum pensylvanicum	OBL	0.94		
Polygonum spp.			0.08	1.28
Ratibida tagetes	NI			0.97
Rock				0.01
Unidentified forb				0.12
Rorippa sinuata	FACW	3.14		
Water		24.69		
# quadrats		35	24	141

PLAYA 9

Sampled: October 20, 1998
Treatment: Alkaline
Estimated Size: 7.1 acres

Location

Quad Map: Indian Bathtub
County: Harding
Elevation: 4,523 feet
UTM's: N3959741 E629147
Lat/Long: 35.7750 103.5787
Township/Range/Section: T18N R32E, Sec. 19
Local Directions: From Mosquero, head west on State Road 29 for about 9.5 miles; turn north on State Road 102 (65) and go until the paved road ends. From where the dirt road starts, travel 7.4 miles to a turnoff heading south. Travel on this road for 5.2 miles (over 3 cattle guards), and turn off to the west on a well-travelled road. Go down this road for 0.8 miles to a faint turn-off heading northwest – there is an old trough at this turnoff with a mesquite bush growing in it. Follow this road for 0.3 miles to a gate; from this gate the playa is less than ¼ mile to the northeast. The area from the final turnoff to the gate is David Watley's private land and he should be contacted prior to a visit.

Water Features: There was no water in the playa at the time of sampling but water was seen in this playa during the reconnaissance flight.

pH = 8.97; specific conductance = 2175 μmohs; salinity = 0.01 ppt.

Landscape Features: The playa basin floor is extremely flat, well-defined and devoid of vegetation. Short, steep, vegetated slopes determine the playa boundaries, and are sharply differentiated from the sandy red dunes surrounding the basin.

Vegetation Description: Zone 1 of both transects represents the flat basin floor and is essentially devoid of vegetation, although there are small patches of saltgrass (*Distichlis spicata*) on the basin floor. Zone 2 occurs on the playa slope and is dominted by alkali sacaton (*Sporobolus airoides*) along with saltgrass and patches of windmill grass. Zone 3 is only weakly differentiated from Zone 2 but occurs further upslope and shows blue grama (*Bouteloua gracilis*) beginning to assume dominance over alkali sacaton. Saltgrass and windmill grass are still conspicuously present in this zone.

Wildlife Notes: Very little in evidence, some passerines.

Soils

Surrounding soils (Harding County Soil Survey): Surrounding soils are a mix of coarse-loamy, mixed, mesic Ustollic Haplargids, mixed thermic Typic Ustipsamments and fine-loamy, mixed thermic Aridic Paleustalfs derived from sandy eolian and alluvium and are of the Springer-Tivoli-Amarillo Association.

Playa basin soil (Sampled along Transect A):

Zone 1 (1st sample): Chromic Haplotorrerts

A1: 0 to 9 cm; light brownish gray (10YR 6/2 ped/dry); sandy clay loam (clay 35%), grayish brown (10YR 5/2 rub/moist); coarse platy; common small pores; abrupt boundary.

C1: 9 to 46 cm; reddish brown (5YR 5/4 ped/moist); clay loam (clay 40%); massive; many red mottles and common black mottles. Salt crust on surface; soil cracks 1 cm wide and 2-5 cm deep.

Sampling location: Station 1

Zone 1 (2nd sample): Haplargid

A1: 0 to 5 cm; very pale brown (10YR 7/3 ped/dry); sandy loam (clay 20%), light brownish gray (10YR 6/2 rub/moist); fine granular; abrupt boundary.

Bt1: 5 to 44 cm; grayish brown (10YR5/2 ped/moist); clay loam (clay 40%); massive; many red mottles at 37 cm. Moist at 6 cm. No cracks on surface.

Sampling location: Station 2 – edge of playa bottom; not inundated recently, no cracks, no vegetation.

Zone 2: Haplargid

A1: 0 to 5 cm; very pale brown (10YR 7/3 ped/dry); loamy sand (clay 10%), pale brown (10YR 6/3 rub/moist); few red mottles; fine granular; common fine, common medium roots; abrupt boundary.

Bt1: 5 to 42 cm; grayish brown (10YR 5/2 ped/dry); sandy clay loam (clay 35%), few red mottles; medium angular blocky; very few fine roots.

Sampling location: Station 3

Zone 3 (1st sample): Haplargid

A1: 0 to 3 cm; light yellowish brown (10YR 6/4 ped/dry); loamy sand (clay 10%), yellowish brown (10YR 5/4 rub/moist); few medium, few fine roots; abrupt boundary.

Bt1: 3 to 38 cm; yellowish brown (10YR 5/4 ped/dry); sandy clay loam (clay 35%), light brownish gray (10YR 6/2 rub/moist); common black mottles; coarse subangular blocky; few fine roots.

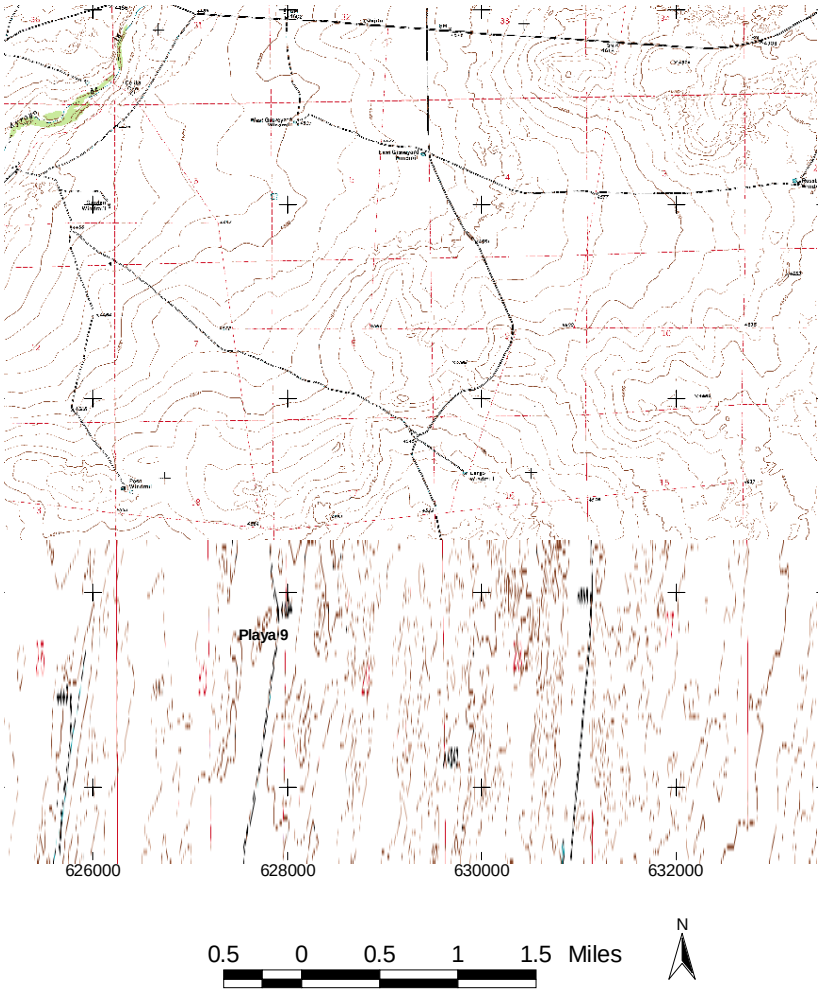
Sampling location: Station 5

Zone 3 (2nd sample): Haplargid

A1: 0 to 3 cm; loamy sand (clay 10%), brown (10YR 5/3 rub/moist) to yellowish brown (10YR5/4 crush/dry); fine granular; common medium roots; clear boundary.

Bt1: 3 to 45 cm; yellowish brown (10YR 5/4 ped/dry); sandy loam (20%), grayish brown (10YR 5/2 rub/moist), medium subangular blocky; few fine roots.

Sampling location: Station 7.



Location of Playa 9, Indian Bathtub Quadrangle

Average cover type values for Playa 9, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria			0.39	0.97
Bare Soil		98.81	70.75	64.34
Bouteloua gracilis	NI		0.69	18.63
Chloris verticillata	NI		0.28	1.87
Digitaria cognata				0.08
Distichlis spicata	FACW	0.08	6.36	3.21
Gutierrezia sarothrae	NI			0.39
Litter		0.10	5.58	4.95
Opuntia phaeacantha	NI			0.13
Schedonnardus paniculatus	NI			0.84
Sporobolus airoides	FAC	0.58	15.94	9.58
# quadrats (n)		105	36	38

Average cover type values for Playa 9, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Bare Soil		98.52	62.75	64.38
Bouteloua gracilis	NI		0.00	8.75
Chloris verticillata	NI		1.44	3.88
Distichlis spicata	FACW	0.22	1.13	2.75
Litter		0.39	5.75	6.25
Sporobolus airoides	FAC	0.87	28.94	14.00
# quadrats (n)		180	16	8

PLAYA 10

Sampled: October 20, 1998
Treatment: Modified
Estimated Size: 11 acres

Location

Quad Map: Kansas Valley
County: Harding
Elevation: 5,690 feet
UTM's: N3987749 E580836
Lat/Long: 36.0347, 104.1073
Township/Range/Section: T21N R27E, Sec. 19
Local Directions: From Roy, head north on State Road 120 for about 9 miles. The road dips into a depression here (the Kansas Valley) and there is a section road with a gate about ¾ mile before you pass the playa. Take this road to get through the fence and backtrack to the playa.

Water Features: The south end has been deepened to make a stock tank that prevents inundation of the rest of the basin.

pH = 8.23; specific conductance = 183 μmhos; salinity = 0 ppt.

Landscape Features: There are several small, deep holes in the basin floor - apparently man-made, whose purpose is unknown. Perhaps they drain basin water to the stock tank. This is a mid-size playa within the rolling grassy plains.

Vegetation Description: This is a fairly homogenous playa, with weakly differentiated zones. Western wheatgrass (*Pascopyrum smithii*) dominates the center of the playa in Zone 1 with small amounts of other grasses mixed in, notably walking stick grass (*Schedonnardus paniculatus*) and buffalo grass (*Buchloe dactyloides*) mixed in. Zone 2, towards the edge of the basin bottom, is distinguished by an increase in dominance of buffalo grass, although western wheatgrass still has a strong presence. Zones 2 and 3 are weakly separated, with Zone 3 representing the playa slope. Western wheatgrass cover drops off, and blue grama (*Bouteloua gracilis*) starts to increase in cover, but buffalo grass still dominates.

Wildlife Notes: None observed (raining during sampling).

Soils

Surrounding soils (Harding County Soil Survey): Surrounding soils are fine-loamy, mixed, mesic Typic Calciustolls and fine-silty, carbonatic, mesic Ustic Torriorthents derived from calcareous alluvium and eolian deposits of the Campus loam (3-9%slopes) and Karde loam (1-9% slopes) soil series.

Playa basin soil (sampled along Transect B):

Zone 1: Aridic or Calcic Haplustert

C1: 0 to 40 cm; grayish brown (2.5Y 5/2 ped/dry); clay (100%), very dark gray (2.5Y 3/1 rub/moist); many large orange mottles; massive; common medium roots to 8 cm. Moist at 5 cm.

Sampling location: Station 1

Zone 2: Torrertic Paleustoll

A1: 0 to 3 cm; dark grayish brown (10YR 4/2 ped/dry); loam (clay 35%), very dark grayish brown (10YR 3/2 rub/moist); medium subangular blocky; common fine roots; clear boundary.

Bt1: 3 to 40 cm; dark grayish brown (10YR 4/2 ped/dry); clay loam (clay 65%), very dark grayish brown (10YR 3/2 rub/moist); coarse subangular blocky; very few fine, very few medium roots.

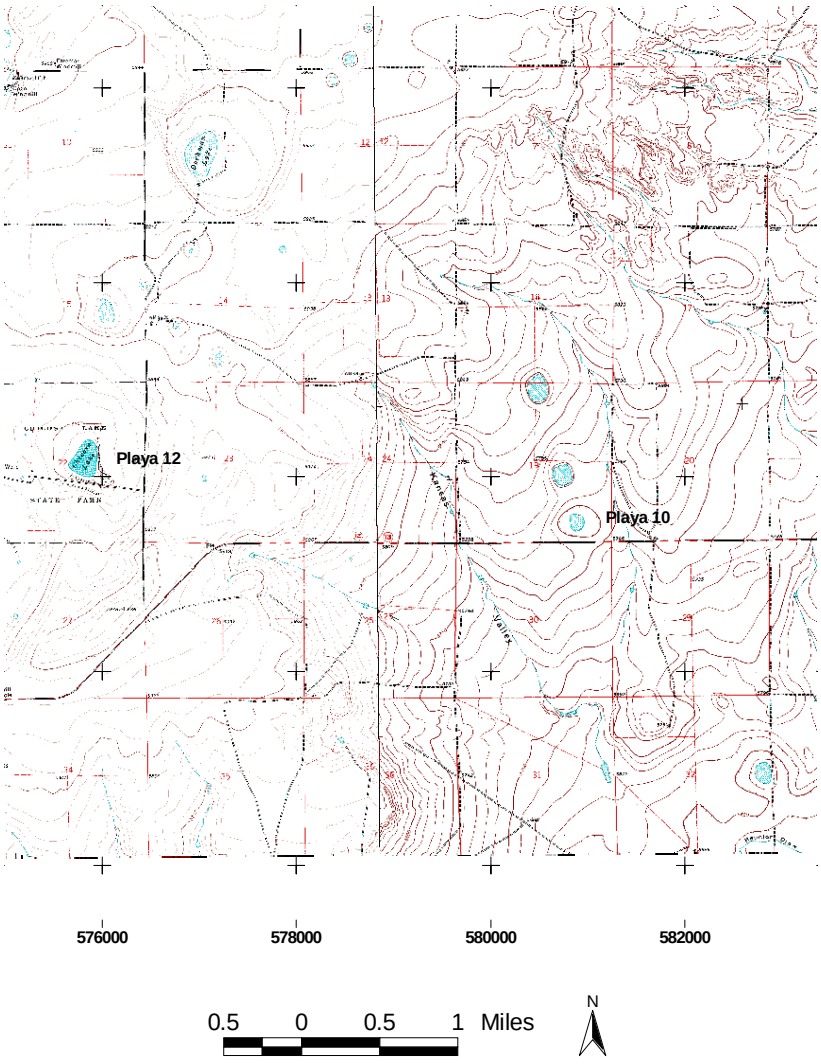
Sampling location: Between Stations 2 and 3

Zone 3: Torrertic Paleustoll

A1: 0 to 6 cm; brown (10YR 4/3 ped/dry); loam (clay 40%), dark brown (10YR 3/3/ rub/moist); fine subangular blocky; many medium, many fine roots; clear boundary.

Bt1: 6 to 35 cm; brown (10YR 4/3 ped/dry); clay loam (clay 75%), dark grayish brown (10YR 4/2 rub/moist); coarse subangular blocky; very few fine roots.

Sampling location: Station 5



Location of Playas 10 and 12, Kansas Valley Quadrangle

Average cover type values for Playa 10, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria			0.03	4.12
Bare Soil		30.55	31.54	30.26
Bouteloua gracilis	NI		0.05	5.88
Buchloe dactyloides	FACU	0.14	14.92	46.56
Iva axillaris	FAC			0.16
Litter		23.72	22.19	6.25
Pascopyrum smithii	FAC-	45.38	27.42	2.30
Phyla nodiflora	FACW	0.20	1.03	0.12
Polygonum pensylvanicum	OBL		0.01	
Schedonnardus paniculatus	NI	0.15	2.81	2.11
Sphaeralcea spp.				0.39
Sporobolus cryptandrus	FACU-			0.84
# quadrats (n)		65	78	57

Average cover type values for Playa 10, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Algae/Cyanobacteria				2.41
Amaranthus spp.			0.03	
Bare Soil		49.94	19.38	9.82
Bouteloua gracilis	NI	0.09		6.73
Buchloe dactyloides	FACU	3.01	26.28	59.32
Iva axillaris	FAC			0.09
Litter		15.35	21.87	10.73
Pascopyrum smithii	FAC-	27.91	31.26	7.09
Phyla nodiflora	FACW	0.14	0.08	0.05
Schedonnardus paniculatus	NI	3.50	1.10	1.36
Sporobolus airoides	FAC	0.04		
Sporobolus cryptandrus	FACU-			0.73
# quadrats (n)		139	39	22

PLAYA 11

Sampled: October 21, 1998
Treatment: Modified
Estimated Size: 26 acres

Location

Quad Map: Point of Rocks
County: Colfax
Elevation: 6,584 feet
UTM's: N4032927 E569014
Lat/Long: 36.4457, 104.2325
Township/Range/Section: T26N R25E, Sec. 26
Local Directions: Head east from Springer for 25 miles to the Point of Rocks/Dorsey Mansion turnoff. Head north on this road for just over 8 miles; then turn west (left) on the faint two-track just past the cattleguard and travel on this road for just over 2 ½ miles (through one gate). Turn to the north and the playa is visible just over the crest of the hill.

Water Features: There is a stock tank (about 2 feet deep) at the west end of this playa. The playa is probably inundated to a few inches each year, but the combination of very large area combined with the presence of the stock tank probably limits inundation. The stock tank has been in existence since at least 1974 (the date of the topo map).

pH = 7.42; specific conductance = 218 μmhos; salinity = 0 ppt.

Landscape Features: This very large playa with a very large flat bottom. A drainage leads into the drainage from the southeast side. Surrounding rolling hills are grassland.

Vegetation Description: Zone 1, in the central basin bottom, is nearly homogenous over a large area. Poverty sumpweed (*Iva axillaris*) dominates the basin floor, with some conspicuous patches of western wheatgrass (*Pascopyrum smithii*) or spreading yellowcress (*Rorippa sinuata*). Zone 2 of Transect A is intermediate between the bottom and the upland with buffalo grass (*Buchloe dactyloides*), poverty sumpweed and western wheatgrass co-occurring in about equal amounts. Zone 3 of Transect A shows an increase in buffalo grass, the appearance of blue grama (*Bouteloua gracilis*) and some western wheatgrass still mixed in. Transect B separates into only two zones, with zone 2 characterized by an abundance of buffalo grass, and very low cover of other species.

Wildlife Notes: Two flocks of migrating sandhill cranes overhead.

Soils

Surrounding soils (Colfax County Soil Survey): The surrounding soils are fine, mixed, mesic Torrertic Argiustolls derived from fine alluvium and eolian deposits and are of the LaBrier silt loam series.

Playa basin soil (Sampled along Transect A):

Zone 1: Haplustert

A1: 0 to 3 cm; grayish brown (2.5Y 5/2 ped/dry); sandy clay (clay 50%), gray (2.5Y 5/1 rub/moist); coarse platy; few medium roots; clear boundary.
C1: 3 to 30 cm; dark grayish brown (2.5Y 4/2 ped/dry); clay (90%), very dark gray (2.5Y 3/1 rub/moist); few orange mottles; massive; few medium roots.
Soil cracks to 0.5 cm wide and 1 cm deep.
Sampling location: Station 2

Zone 2: Haplustert

A1: 0 to 3 cm; grayish brown (2.5Y 5/2 ped/dry); sandy clay (clay 50%), dark gray (2.5Y 4/1); medium platy; few medium roots; clear boundary.
C1: 3 to 28 cm; dark grayish brown (2.5Y 4/2 ped/dry); clay (95%), very dark gray (2.5Y 3/1 rub/moist); massive; few calcic nodules.
Soil cracks to 0.25 wide and 0.5 deep.
Sampling location: between Stations 5 and 6

Zone 3: Torrertic Argiustoll

A1: 0 to 7 cm; grayish brown (2.5Y 5/2 ped/dry); clay loam (clay 35%), dark gray (2.5Y4/1 rub/moist); medium platy; few large pores; many fine roots; clear boundary.
Bt1: 7 to 30 cm; dark grayish brown (2.5Y 4/2 ped/dry); sandy clay loam (clay 35%), dark gray (2.5Y 4/1 rub/moist); few red mottles; few fine roots.
Soil cracks to 2 cm wide and 3 cm deep.
Sampling location: Station 9

Average cover type values for Playa 11, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Astragalus spp.		0.01		0.05
Atriplex canescens	UPL			1.20
Bare Soil		84.32	84.86	67.68
Bouteloua gracilis	NI			2.66
Buchloe dactyloides	FACU	0.19	5.14	21.93
Eleocharis spp.		0.00		
Iva axillaris	FAC	10.86	4.46	0.98
Litter		0.89	1.94	2.95
Pascopyrum smithii	FAC-	1.59	3.63	1.95
Phyla nodiflora	FACW	0.04		0.57
Polygonum pensylvanicum	OBL	0.08		
Rock		0.08		0.11
Rorippa sinuata	FACW	2.01		
Sphaeralcea spp.			0.03	0.25
# quadrats (n)		308	65	44

Average cover type values for Playa 11, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2
Artemisia frigida	NI		0.16
Astragalus spp.			0.05
Bare Soil		86.20	37.35
Bouteloua gracilis	NI		1.69
Buchloe dactyloides	FACU	1.59	54.77
Cuscuta cuspidata	NI	0.02	
Iva axillaris	FAC	6.26	2.58
Litter		1.16	1.92
Pascopyrum smithii	FAC-	1.86	1.06
Phyla nodiflora	FACW	0.07	
Polygonum pensylvanicum	OBL	0.52	
Rock		0.13	
Rorippa sinuata	FACW	2.11	0.24
Schedonnardus paniculatus	NI	0.19	0.16
# quadrats (n)		257	62

PLAYA 12

Sampled: October 3, 1998
Treatment: Alkaline
Estimated Size: 20.2 acres

Location

Quad Map: Mills East
County: Harding
Elevation: 5,743 feet
UTM's: N3988417 E575776
Lat/Long: 36.0347, 104.1609
Township/Range/Section: T21N R26E, Sec. 22
Local Directions: From Roy, head north on State Road 120 for about 7 miles. Here, there is a country road heading north with a marker for the (now closed) Chicosa state park; head north on this for 1 mile. The entrance to Chicosa Park is to the west.

Water Features: This playa used to be permanently filled through a diversion of water by the farmer to the northeast; now it is dependent on runoff. Water is clear, shallow, and cold. Pooling is near the north end, not in the center.

pH = 9.26; specific conductance = 12,709 μmhos; salinity = 0.1 ppt.

Landscape Features: This playa has a very flat, large, well-defined basin bottom. Slopes are steep, and highest at the south end (up to 50 m high). There is some bank erosion along the east side.

Vegetation Description: Zone 1 of both transects represents the basin bottom and is essentially barren. Zone 2 is dominated by annuals (primarily kochia [*Kochia scoparia*] and seepweed [*Suaeda* spp.]), with lower cover of the perennials saltgrass (*Distichlis spicata*) and Canada wildrye (*Elymus canadensis*), both wetland indicators. These perennial grasses increase upslope to become co-dominants in Zone 3. The wetland nature of Zone 3 is further emphasized by the small amount of American bulrush (*Schoenoplectus americanus*) present in both transects.

Wildlife Notes: Blue heron, harrier, barn swallows, meadowlarks.

Soils
Surrounding soils (Harding County Soil Survey): Surrounding soils are fine, mixed, mesic Aquic Camborthids derived from clayey, calcareous, alkaline water-laid sediments on benches surrounding the playa and are of the Church clay loam (0-2% slope) mapping unit.

Playa basin soil (sampled along Transect A):

Zone 1: Haplustert or Calciustert

A1: 0 to 1 cm; gray (2.5Y 5/1 ped/dry); clay loam (clay 40%), dark gray (2.5Y 4/1 rub/moist); medium platy; clear boundary.

C1: 2 to 52 cm; clay (90%), very dark grayish brown (2.5Y 3/2 rub/moist); massive. Extensive cracking, salty crust about 1mm thick. Moist at 7cm.

Sampling location: Station 1

Zone 2: Ustic Endoaquert

A1: 0 to 10 cm; gray (2.5Y 6/1 ped/dry); clay loam (40%), grayish brown (2.5Y 5/2 rub/moist); medium subangular blocky; many fine roots; clear boundary.

C1: 10 to 40 cm; grayish brown (2.5Y 5/2 ped/dry); sandy clay loam (clay 35%), gray (2.5Y 5/1 rub/moist); common red mottles, common calcic nodules; medium angular blocky; few fine roots.

Salty crust and surface cracks to 6 cm deep.

Sampling location: Station 3

Zone 3: Ustic Haplocambid

A1: 0 to 5 cm; grayish brown (2.5Y 5/2 ped/dry); clay loam (clay 25%), dark gray (2.5Y 4/1 rub/moist); medium subangular blocky; common medium roots; clear boundary.

B1: 5 to 36 cm; light gray (2.5Y 7/2 ped/dry); sandy clay loam (clay 35%), gray (2.5Y 5/1 rub/moist); coarse subangular blocky; very few fine roots.

Salty crust on soil and many gopher mounds.

Sampling location: Station 7

Uplands: Haplargid

A1: 0 to 2cm; very dark grayish brown (10YR 3/2 ped/dry); sandy loam (clay 15%), very dark brown (10YR 2/2 rub/moist); very fine subangular blocky; common fine and common medium roots; abrupt boundary.

Bt1: 2 to 38 cm; dark grayish brown (10YR 4/2 ped/dry); clay loam (clay 40%), dark gray (10YR 4/1 rub/moist); medium subangular blocky; very few fine, very few medium roots.

Sampling location: Top of slope, near road. Vegetation is blue grama, saltgrass, snakeweed.

Average cover type values for Playa 12, Transect A

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Amaranthus palmeri			1.58	
Bare Soil		99.78	39.47	20.45
Distichlis spicata	FACW		2.50	64.10
Elymus canadensis	FAC		15.34	6.19
Kochia scoparia	FAC		17.58	0.05
Litter			15.00	17.79
Polygonum spp.			0.05	0.05
Schoenoplectus americanus	OBL			0.90
Suaeda spp.		0.22	8.21	
# quadrats (n)		323	38	42

Average cover type values for Playa 12, Transect B

Species Name	Wetland Status	Mean cover (%) Zone 1	Zone 2	Zone 3
Amaranthus palmeri			1.94	
Bare Soil		230.20	48.39	11.77
Distichlis spicata	FACW		3.06	36.88
Elymus canadensis	FAC		18.81	3.56
Kochia scoparia	FAC		21.55	0.03
Litter			18.39	10.23
Polygonum spp.			0.06	0.03
Schoenoplectus americanus	OBL			0.52
Suaeda spp.		0.51	10.06	
# quadrats (n)		140	31	73