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Cover: Desert bluebells in a dry wash in the Mojave Desert, CA.

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Abstract: The U.S. Army Corps of Engineers is currently regionalizing and updating the national wetland delineation manual. This manual will use new ecosystem boundaries for the nation. A separate effort by the Corps will update the National Wetland Plant List within these same new ecosystem boundaries. The Arid West is an area of particular interest in the revision of the plant list because of the problematic indicator statuses for certain groups of plants. Many species in the Arid West have morphological and physiological adaptations that allow them to occur in specialized habitats, ranging from wetlands to uplands. In delineations, the indicator status of these species is not always accurate for the specific location. A combination of literature reviews and recorded species data from previous studies for six specialty habitats are presented and discussed; the species groups are playa edge species, dry wash species, dry wash phreatophytes, hygro-halophytes, xero-halophytes, and phreatophytes with salt tolerance. A total of 421 species, with 93 of those species shared in more than one habitat type, are reported, including 48 playa species, 346 dry wash species, 62 dry wash phreatophytes, 32 hygro-halophytes, 47 xero-halophytes, and 17 phreatophytes with salt tolerance. The list for each specialized habitat will be used to better understand species ecology and occurrences across the region and will ultimately help in assigning and increasing the reliability of wetland plant indicator statuses.

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Preface

This report was prepared by Robert W. Lichvar and Lindsey Dixon, Remote Sensing/GIS and Water Resources Branch, Cold Regions Research and Engineering Laboratory (CRREL), U.S. Army Engineer Research and Development Center (ERDC), Hanover, NH.

Many military installations over the years supported various types of studies that helped in generating a list of species that could be used in this study. These include White Sands Missile Range, NM; Edwards Air Force Base (AFB), CA; Dugway Proving Ground, UT; Twenty Nine Palms Marine Corps Base, CA; Camp Pendleton, CA; and Miramar Marine Corps Station, CA. Many supporters of other studies allowed for a robust list to be developed in this region, including the Navajo Nation and the San Francisco, Los Angeles, and Sacramento Districts, Corps of Engineers. The authors thank David Charlton of Edwards AFB for making comments on the list of species and their synonyms and Corinna Photos for reviewing and editing the manuscript. Finally they thank the vegetation working group for the Arid West wetland supplement, who felt that there was a need for such a list and discussion and that it would be helpful for wetland delineation purposes.

The report was prepared under the general supervision of Timothy Pangburn, Chief, Remote Sensing/GIS and Water Resources Branch; Dr. Lance Hansen, Deputy Director; and Dr. Robert E. Davis, Director, CRREL.

The Commander and Executive Director of ERDC is COL Richard B. Jenkins. The Director is Dr. James R. Houston.

1 Introduction

The U.S. Army Corps of Engineers is regionalizing and updating (Wakeley 2002) its national wetland delineation manual (Environmental Laboratory 1987). As part of this effort, the nation is being subdivided along ecosystem boundaries (Fig. 1) similar to those used for the indicators of hydric soils (NRCS 2006b). Starting in 2007, using these same boundaries, the Corps began to regionalize the Corps National Wetland Plant List as part of a Memorandum of Agreement (MOA) between the Corps of Engineers, the Fish and Wildlife Service (FWS), the Natural Resources Conservation Service (NRCS), and the Environmental Protection Agency (EPA). One of these new regions (the Arid West)

Figure 1. Plant list regional boundaries (red lines) currently used by the U.S. Fish and Wildlife Service's National Wetlands Inventory in the Arid West.

comprises five former U.S. Fish and Wildlife Service (FWS) regional areas. The FWS regional areas were defined by administrative boundaries and were previously used for regional wetland plant indicator status lists (Reed 1988). Due to the updating of the National Wetland Plant List along ecosystem boundaries, only those wetland species occurring within the new boundary of the Arid West region will be included in the revision of the wetland plant list for the region. In the new Arid West region, along with other new regions nationally, the ecosystem boundaries will be more closely aligned with climatic, geologic, landform, other environmental condition, and there will be an increased similarity of floristic composition within the region. The use of ecosystem boundaries for wetland plant lists in different regions will increase the reliability and accuracy of the wetland plant indicator statuses.

Species containing ecotypes or those with wide ecological amplitudes (Tiner 2006) can make determinations of hydrophytic vegetation challenging if they have the ability to occur in multiple habitats that range from wetlands to uplands. In the Arid West, certain species are located in specialized habitats, including riparian corridors, playas, and saline areas. Many of these habitats can be considered either wetlands or uplands, depending on specific site conditions. In wetland delineation, these habitats can be problematic when the vegetation is a mixture of hydrophytes (plants occurring in wetlands) and other species that have physiological or morphological adaptations for growing in these specialized western habitats (Gibson 1996, Nilsen et al. 1984, Hunt 1966). This is especially true if all of these adaptations are not factored into the wetland rating.

In wetland delineation, the determination of the presence or absence of hydrophytic vegetation at a site requires the use of species abundances, wetland indicator status ratings (Reed 1988), and several mathematical formulas to determine if hydrophytes dominate the site. For a reliable determination of hydrophytic vegetation, it is critical that a species be accurately assigned a wetland indicator status based on its frequency of occurrence in wetlands in the region (Table 1). The ability to sort these occurrences into different habitats or adaptations adds clarity to the wetland plant ratings. For instance, many of the specialized western habitats are highly saline areas with groundwater deeper than that required to be considered a wetland. In the Arid West many species have evolved morphological or physiological adaptations that allow them to

Table 1. Indicator categories.

Indicator code	Category	Definition	% Occurring in wetlands
OBL	Obligate Wetland	Occurs almost always in wetlands under natural conditions	>99%
FACW	Facultative Wetland	Usually occurs in wetlands, but often found in non-wetlands	67–99%
FAC	Facultative	Equally likely to occur in wetlands or non-wetlands	34–66%
FACU	Facultative Upland	Usually occurs in non-wetlands, but often found in wetlands	1–33%
UPL	Obligate Upland	Occurs almost always in non-wetlands under natural conditions	<1%
NA	No agreement	The regional panel was not able to reach a decision on this species.	N/A
NI	No indicator	Insufficient information was available to determine an indicator status.	N/A
NO	No occurrence	The species does not occur in that region.	N/A
(+) or (-)	Facultative	A positive (+) or negative (–) sign was used with the Facultative indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands). A negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).	
An asterisk (*) following a regional indicator identifies uncertain designations based on limited information from which to determine the indicator status.			

inhabit these sites. Clarifying differences in occurrences in specialized habitat types, such as wetlands, other waters of the United States (WoUS), or uplands allows for a better understanding of a species and its frequency of occurrence in wetlands, and this in turn will increase the reliability of wetland indicator statuses.

To support the updating of the vegetation section of the Arid West Regional Supplement and the revision of the Corps National List of Wetland Plants, an effort was undertaken to identify some of the specialized habitats of the Arid West and compile species lists for these habitats. To further assist regional panels of wetland specialists and botanists in assigning indicator statuses to these species, a detailed habitat description or discussion of morphological and physiological adaptations of species was developed using the literature and field knowledge to circumscribe these habitats for the Arid West. Previous efforts for reporting lists of species from these habitats in the literature generally provided only short representative lists of species as examples from these habitats, or small groups of species capable of expressing certain types of adaptations. In this report, we present comprehensive lists of species associated with these habitats as a result of the compilation of species reported in the literature combined with extensive field records from many unique western habitats. It is our intent that these expanded lists will assist the new regional Arid West wetland supplement and the new Arid West regional wetland plant list panel in acknowledging and appreciating the ecological amplitude of these desert specialists.

2 Study Area

The ecosystem boundaries of this region follows the outline of the Arid West regional wetland supplement (U.S. Army Corps of Engineers 2006) and is overlain with the plant list regional boundaries currently used by the Fish and Wildlife Service (Fig. 1) (Reed 1988). This region contains mainly the lower elevation basins and does not include some of the higher elevation mountainous areas contained within the region; those are included in the Western Mountains, Valleys and Coast supplement (U.S. Army Corps of Engineers, in prep.). The region includes three main ecological habitats: the warm and cold deserts and the parts of California influenced by a Mediterranean climate.

3 Methods

An initial literature review was performed to identify species with physiological or morphological adaptations for life in specialized habitats. Unfortunately, the literature did not provide extensive lists of species for these habitats; therefore, personal data from the senior author's collection within this region during watershed-scale wetland delineations and other ecological studies completed over close to two decades were used to supplement the literature lists. The species lists compiled from the field records came from actual species observations recorded on data sheets. Species data were stored digitally, and records were supported by soils data and other site descriptions including geographic coordinates. The field data were sorted by habitat types and grouped into specialty categories. Data were then merged with the lists compiled from the literature to obtain the final version of species lists in each specialty habitat type.

Identification of species was done using many regional and local floras covering several floristic regions, including the Sonoran, Colorado Plateau, Great Basin, Chihuahuan, Apachian, Peninsular, Columbia Plateau, South Rocky Mountains Mogollon, and the Mojave areas (McLaughlin 1989). The groups of specialty habitats were developed from the literature and field visits to various locations. After species lists for each specialty group were compiled, wetland indicator statuses from the five FWS regions contained in the Arid West Region (Regions 6, 7, 8, 9, and 0) were derived from the 1988 Plant List (Reed 1988). Because of variations of synonyms in various floras across the region, depending on the date of publication, the synonyms were standardized using the List 88 names (Reed 1988) and their wetland plant indicator statuses. Current synonyms for many species are also provided based on the USDA PLANTS database (2007).

4 Results

Group Descriptions

The following discussion describes the specialty habitats and the adaptive physiological and morphological features of the species that inhabit them. We report a total of 421 species, with 93 of those species shared in more than one habitat type. There were 48 playa species, 346 dry wash species, 62 dry wash phreatophytes, 32 hygro-halophytes, 47 xero-halophytes, and 17 phreatophytes with salt tolerance.

Playa Edges

Playas can be defined as the flat, lower portions of an arid basin with internal drainage that pond water periodically and accumulate sediment (Stone 1956). Because of harsh physical conditions within a playa, such as compacted soil, high salinity, and unpredictable cycles of inundated/dry conditions, much of the vegetation is restricted to the edge of the playa (Lichvar et al. 2006). Two types of playas exist: hard and soft playas (Stone 1956). Hard playas lack groundwater within 5 m from the surface, while soft playas typically have groundwater within 5 m of the surface (Motts 1970, Neal 1975). These two conditions influence the type of plant species and communities present along the playa edge. Hard playa vegetation varies from xerophytic species (found in saline dry habitats) that closely resembles upland conspecific species, to halophytic species (found in saline wet habitats) of the "alkaline sink scrub" vegetation type (Barbour et al. 1987). Soft playa vegetation consists of succulent chenopods of the "alkaline sink scrub" (Lichvar et al. 2006).

Thorne (1976) classified vegetation found along playa edges as "alkaline scrub," which generally consists of scattered scrub of halophytic plants mostly in the Chenopodiaceae, Asteraceae, Brassicaceae, Fabaceae, and Poaceae families (Barbour and Billings 1988). Barbour and Billings (1988) also stated that 20% of this vegetation type consists of monocultures of single-perennial-species dominance. Vegetation found along the playa edges is often found on phreatophytic mounds (raised accumulations of soil and vegetation) that are 1–5 m high and have a circumference of 2–10 m (Lichvar et al. 2006, Lichvar and Sprecher 1996). The mounds form when wind-blown sand and silt accumulate around a phreatophyte (species that have their roots in perennial groundwater or in the capillary fringe above the water table) (Hunt 1966) growing at the level of the playa surface and build successively upward (Lichvar et al. 2006). As you move away from the playa edge, salinity decreases; as a result the vegetation shifts from halophytic to xerophytic salt bush species, with a transition zone between the two stands. The xerophytic zone is then replaced by the Creosotebush community (Lichvar and Pringle 1992). Between the sandy edge of the playa and the foot of the mountains are highly permeable gravel fans where the water table is deep and xerophytes are able to thrive (Hunt 1966). Lower in elevation, some boundaries are seen where these gravel fans grade into sand at the edge of the playa; this boundary also correlates with the availability of groundwater. Adaptations expressed by the plants around the playa edge can include both salt- and drought-tolerance, depending on the species site requirements. Field experience has shown that the reliability of the status ratings of wetland plant species as indicators along playa edges is compromised by halophytes and phreatophytes responding to saline soils and groundwater at depths greater than the surface or near-surface hydrology required to meet wetland criteria (Lichvar et al. 2006). A list of 48 playa edge species is presented in Table 2.

Table 2. Species found along playa edges.

1988 synonymy	Current name	Playa type*	Region 6	Region 7	Region 8	Region 9	Region 0
Acamptopappus sphaerocephalus (Harvey & Gray ex Gray) Gray 1,2		H	UPL	UPL	UPL	UPL	UPL
Allenrolfea occidentalis (S. Wats.) Kuntze		SH	FACW	FACW	FACW	FACW+	FACW+
Artemisia spinescens D.C. Eat 7	*Picrothamnus desertorum* Nutt.	H	UPL	UPL	UPL	UPL	UPL
Atriplex canescens (Pursh) Nutt. 2, 4,6,7		H	UPL	UPL	UPL	UPL	FACU
Atriplex confertifolia (Torr. & Frém.) S. Wats. 2,7,8		H	UPL	UPL	UPL	UPL	UPL
Atriplex lentiformis (Torr.) S. Wats. 2,6,7		SH	NO	FACW	FAC+	NO	FAC
Atriplex phyllostegia (Torr. Ex.S. Wats.) S. Wats. 6		H	NO	NO	FACW	NI	FACW
Atriplex polycarpa (Torr.) S. Wats. 2		H	NO	FACU-	FACU	NO	FACU
Atriplex spinifera J.F. Macbr.		H	NO	NO	NO	NO	FAC
Atriplex torreyi (S. Wats.) S. Wats 8		H	NO	NO	FAC-	NO	FAC

Table 2 (cont.). Species found along playa edges.

Chrysothamnus nauseosus (Pallas ex Pursh) Britt ssp. *mohavensis* (Greene) Hall & Clements 6	*Ericameria nauseosa* (Pallas ex Pursh) Nesom & Baird ssp. *consimilis* (Greene) Nesom & Baird var. *mohavensis* (Greene) Nesom & Baird	H	UPL	UPL	UPL	UPL	UPL
Delphinium recurvatum Greene 7		H	UPL	UPL	UPL	UPL	UPL
Distichlis spicata (L.) Greene 5,6		SH	FACW+	FACW	FAC+*	FACW	FACW
Erigeron bellidiastrum Nutt. 12		H	UPL	UPL	UPL	UPL	UPL
Forestiera neomexicana Gray	*Forestiera pubescens* Nutt		FAC-	FACU	FAC+	NO	FAC
Frankenia grandifolia Cham. & Schlecht. 7	*Frankenia salina* (Molina) I.M. Johnston	S	NO	NO	NO	NO	FACW+
Geraea canescens Torr. & Gray		H	UPL	UPL	UPL	UPL	UPL
Grayia spinosa (Hook.) Moq. 7		SH	UPL	UPL	UPL	UPL	UPL
Isocoma acradenia (Greene) Greene		H	NO	NI	NI	NO	NI
Helianthus ciliaris D.C.12		H	FAC	FAC	NI	NI	NI*
Heliotropium curassavicum l.7		SH	FACW	FACW*	OBL	OBL	OBL
Hoffmannseggia glauca (Ortega) Eifert 12		H	FAC	FACU	FACU-	NO	FACU
Hymenoclea salsola Torr. & Gray ex Gray 2		H	UPL	UPL	UPL	UPL	UPL
Hymenoxys odorata D.C. 12		H	UPL	UPL	UPL	UPL	UPL
Juncus bufonius L.		SH	OBL	OBL	OBL	FACW+	FACW+
Kochia californica S. Wats.2,7,8	*Bassia californica* (S. Wats.) A.J. Scott	SH	NO	NO	FACW	NO	FACW
Lepidium dictyotum Gray 7,		H	NO	NO	FACW+	FACW	OBL
Monolepis nuttalliana (J.A. Schultes) Greene		SH	FACU*	FAC	FACW	FAC-	FACW
Nama demissum Gray		H	UPL	UPL	UPL	UPL	UPL
Nitrophila occidentalis (Moq.) S. Wats 2,7, 6		SH	NO	NO	FAC+	FACW	FACW
Oligomeris linifolia (Vahl) J.F. Macbr.		H	UPL	UPL	UPL	UPL	UPL
Panicum obtusum Kunth 12		H	FAC+	FAC	FACU	NO	NO
Phacelia distans Benth.2		H	UPL	UPL	UPL	UPL	UPL
Pluchea sericea (Nutt.) Coville 2,7		S	NO	NI	FACW-	FACW	NO

Table 2 (cont.). Species found along playa edges.

Polypogon monspeliensis (L.) Desf.		SH	FACW+	FACW+	FACW+	FACW+	FACW+
Psathyrotes ramosissima (Torr.) Gray		H	UPL	UPL	UPL	UPL	UPL
Salicornia subterminalis Parish 2,7	*Arthrocnemum subterminale* (Parish) Standl.	S	NO	NO	NO	NO	OBL
Schismus barbatus (Loefl. ex L.) Thellung		H	UPL	UPL	UPL	UPL	UPL
Scirpus acutus Muhl. ex Bigelow 2	*Schoenoplectus acutus* (Muhl. ex Bigelow) A.& D. Löve	S	OBL	OBL	OBL	OBL	OBL
Sesuvium verrucosum Raf. 7		SH	FACW-	FACW	FACW+	NI	FACW
Sida leprosa (Ortega) K. Schum 7,12	*Malvella leprosa* (Ortega) Krapov.	SH	FAC	FACW	FAC	FACU	FAC*
Sphaerophysa salsula (Pallas) DC. 12		H	NI	NI	FAC	UPL	NI
Sporobolus airoides (Torr.) Torr. 2,7		S	FAC	FAC	FAC	FAC-	FAC+
Sisymbrium orientale L.		H	UPL	UPL	UPL	UPL	UPL
Suaeda suffrutescens S. Wats. 4		SH	UPL	UPL	UPL	UPL	UPL
Suaeda torreyana S. Wats. 2,6,7,7,8	*Suaeda moquinii* (Torr.) Greene	SH	FACW-	FAC	FAC+	FAC	FAC+
Tamarix aphylla (L.) Karst. 4		S	FACW	FAC	FACW	NO	FACW-
Wislizenia refracta Engelm. 7		SH	FACW	FACU-	FACU-	NO	NI

*S = soft playa; H = hard playa; SH = soft and hard playa

1 Barbour and Billings (1988)
2 Barbour and Major (1977)
3 Hunt (1966)
4 Hunt (1975)
5 Scott et al. (2000)
6 Stone (1956)
7 Thorne (1976)
8 Vasek (1983)
9 Wallace et al. (1980)
10 Went and Westergaard (1949)
11 West (1983)
12 Wondzell et al. (1990)

Dry Wash Species

Desert dry wash species occur in dry channel beds of intermittent and ephemeral streams that are dominated by woody phreatophytes, large shrubs, and trees, as well as scattered evergreen and drought-deciduous shrubs. Intermittent stream channels often have a groundwater table close to the surface that allows for a greater diversity of vegetation, while ephemeral streams do not have a water table as close to the surface, therefore limiting the abundance of vegetation (Katz 2004). Many of the species found along dry washes occur in both the dry wash and adjacent upland habitats (Nilsen et al. 1984). As a response to channel disturbance it is common to find upland species that have been washed down into the stream channel during storm events; occasionally upland species invade the stream channel. Dry washes are often dominated by phreatophyte species, which have roots anchored deep below the surface in or near the water table (Rundel and Gibson 1996). However, not all dry wash species are phreatophytes; many other species, such as grasses and shallower-rooted shrubs, rely on groundwater discharge or precipitation (Scott et al. 2000). When there is a slight increase in soil moisture, there is also an increase in vegetation biomass, height, and stem density that is not found in the uplands areas (Lichvar and Wakeley 2004). Otherwise, dry washes tend to have lower species cover values because of frequent disturbances in the wash as a response to storm discharge events, lack of developed soils, and well-drained coarse soil textures that lack soil moisture. These disturbances and stresses affect germination rates and vegetative responses. Larger washes tend to have more scattered trees and shrubs, such as willows (*Salix* spp.), cottonwoods (*Populus* spp.), and mesquites (*Prosopis* spp.), that are able to survive because their root systems have the ability to make contact with deeper groundwater that is lacking immediately outside the slopes of the wash. Researchers in the Southwest have noted that some plant species seem to be restricted as obligate dry wash species, while others take advantage of the water reserves in the channel but are not restricted to it; these are also referred to as facultative dry wash species (Lichvar and Wakeley 2004). Because of these types of observations, Dick-Peddie and Hubbard (1977) noted that obligate riparian species of the Southwest may be facultative in more mesic regions. Table 3 lists 346 dry wash species.

Table 3. Dry wash species.

1988 synonymy	Current name	Region 6	Region 7	Region 8	Region 9	Region 0
Abronia villosa S. Wats. 7		UPL	UPL	UPL	UPL	UPL
Adenostoma fasciculatum Hook. & Arn. 1,2		UPL	UPL	UPL	UPL	UPL
Adenostoma sparsifolium Torr. 1,2		UPL	UPL	UPL	UPL	UPL
Agave americana L. var. *expansa* (Jacobi) Gentry 7		UPL	UPL	UPL	UPL	UPL
Agropyron intermedium (Host) Beauv. var. *trichophorum* (Link) Halac.	*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey	UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Agropyron trachycaulum (Link) Malte 2	*Elymus trachycaulus* (Link) Gould ex Shinners	FAC-	FAC	FACU	FAC	NI*
Agrostis exarata Trin. 2		FACW	FACW	FACW	FACW	FACW
Alisma triviale Pursh		UPL	UPL	UPL	UPL	UPL
Allenrolfea occidentalis (S. Wats.) Kuntze 1,2,10		FACW	FACW	FACW	FACW+	FACW+
Alnus rhombifolia Nutt.		NO	NO	NI	FACW	FACW
Alyssum alyssoides (L.) L.		UPL	UPL	UPL	UPL	UPL
Amaranthus blitoides S. Wats.		FAC	FACU	FACU	FACW	FACW
Amaranthus palmeri S. Wats.		FACU-	FACU	FACU	NO	FACU
Ambrosia acanthicarpa Hook.		UPL	UPL	UPL	UPL	UPL
Ambrosia confertiflora DC.		UPL	UPL	UPL	UPL	UPL
Ambrosia dumosa (Gray) Payne 1,2,7,9		UPL	UPL	UPL	UPL	UPL
Ambrosia psilostachya DC. 2		FAC-	FAC	FACU*	FACU+	FAC
Amorpha fruticosa L.		FACW	FACW+	FACW	NO	FAC*
Amsinckia menziesii (Lehm.) A. Nels. & J.F. Macbr. 2		UPL	UPL	UPL	UPL	UPL
Amsinckia tessellata Gray		UPL	UPL	UPL	UPL	UPL
Anagallis arvensis L.		FACW-	FAC	FAC+	FAC	FAC
Anemopsis californica (Nutt.) Hook. & Arn. 7		FACW+	OBL	OBL	NI	OBL
Apiastrum angustifolium Nutt.		UPL	UPL	UPL	UPL	UPL
Apium graveolens L.		NI	NI	NI	NI	FACW*
Arctostaphylos glauca Lindl. 1,2		UPL	UPL	UPL	UPL	UPL
Artemisia californica Less. 2		UPL	UPL	UPL	UPL	UPL
Artemisia douglasiana Bess. ex Hook.		NO	NO	FAC	FACW	FACW
Artemisia dracunculus L. 2		UPL	UPL	UPL	UPL	UPL
Artemisia filifolia Torr. 1		UPL	UPL	UPL	UPL	UPL
Artemisia ludoviciana Nutt. 2		UPL	UPL	FACU	UPL	FACU-
Artemisia palmeri Gray		UPL	UPL	UPL	UPL	UPL
Artemisia tridentata Nutt. 1,2,7		UPL	UPL	UPL	UPL	UPL
Artemisia tridentata Nutt. ssp. *parishii* (Gray) Hall & Clements 2		UPL	UPL	UPL	UPL	UPL
Arundo donax L. 2,7		FAC+	FACW	FACW	NO	FACW
Aster subspicatus Nees	*Symphyotrichum subspicatum* (Nees) Nesom	NO	NI	FAC	FACW	FAC
Astragalus lentiginosus Dougl. ex Hook.		NO	NI	NI	NI	NI
Atriplex californica Moq.		NO	NO	NO	NO	FAC
Atriplex canescens (Pursh) Nutt. 1,2,7		UPL	UPL	UPL	UPL	FACU

Table 3 (cont.). Dry wash species.

Atriplex confertifolia (Torr. & Frém.) S. Wats. 1,2,7,10		UPL	UPL	UPL	UPL	UPL
Atriplex hymenelytra (Torr.) S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Artemisia ludoviciana Nutt. 2		UPL	UPL	FACU	FACU-*	FACU-
Atriplex parryi S. Wats. 1		NO	NO	FACW	NO	FACW
Atriplex polycarpa (Torr.) S. Wats. 1,2		NO	FACU-	FACU	NO	FACU
Atriplex spinifera J.F. Macbr.1		NO	NO	NO	NO	FAC
Avena barbata Pott ex Link		UPL	UPL	UPL	UPL	UPL
Avena fatua L.		UPL	UPL	UPL	UPL	UPL
Azolla filiculoides Lam.		NO	OBL	NI	OBL	OBL
Baccharis pilularis DC. 1		UPL	UPL	UPL	UPL	UPL
Baccharis sarothroides Gray 1,7		NO	FAC-	NI	NO	FAC
Baccharis viminea DC.	*Baccharis salicifolia* (Ruiz & Pavón) Pers	NI	FACW	FACW	NO	FACW
Barbarea verna (P. Mill.) Aschers.		UPL	UPL	UPL	UPL	UPL
Bassia hyssopifolia (Pallas) Kuntz		FACW-	FACW-	FACW	FACW	FAC
Beckmannia syzigachne (Steud.) Fern.		NO	OBL	OBL	OBL	OBL
Berula erecta (Huds.) Coville		OBL	OBL	OBL	OBL	OBL
Bothriochloa barbinodis (Lag.) Herter		UPL	UPL	UPL	UPL	UPL
Brassica nigra (L.) W.D.J. Koch		UPL	UPL	UPL	UPL	UPL
Brickellia californica (Torr. & Gray) Gray 2		FAC	FACU+	UPL	FACU-	FACU
Briza minor L.		FAC+	NO	NO	FAC	FACW
Bromus carinatus Hook. & Arn.		UPL	UPL	UPL	UPL	UPL
Bromus diandrus Roth 2		UPL	UPL	UPL	UPL	UPL
Bromus mollis L.	*Bromus hordeaceus* L.	UPL	UPL	UPL	UPL	FACU
Bromus rubens L.	*Bromus madritensis* L. ssp *rubens* (L.) Husnot	NI	NI	NI	NI	NI
Bromus tectorum L. 2		UPL	UPL	UPL	UPL	UPL
Calystegia longipes (S. Wats.) brummitt		UPL	UPL	UPL	UPL	UPL
Camissonia claviformis (Torr. & Gr(Torr. & Frém.) Raven 2		UPL	UPL	UPL	UPL	UPL
Cardamine californica (Nutt.) Greene		NO	NO	NO	NI	UPL*
Cardaria pubescens (C.A. Mey.) Jarmolenko		UPL	UPL	UPL	UPL	UPL
Carex barbarae Dewey		NO	NO	NO	FAC+	FACW
Carex praegracilis W. Boott		FACW	FACW+	FACW	FACW	FACW-
Carex spissa Bailey		NO	NI	NO	NO	FAC*
Carex triquetra Boott		UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Caulanthus inflatus S. Wats.		UPL	UPL	UPL	UPL	UPL
Ceanothus crassifolius Torr. 1		UPL	UPL	UPL	UPL	UPL
Ceanothus cuneatus (Hook.) Nutt. 1,2		UPL	UPL	UPL	UPL	UPL
Ceanothus greggii Gray 1,2,7		UPL	UPL	UPL	UPL	UPL
Ceanothus tomentosus Parry 1,2		UPL	UPL	UPL	UPL	UPL
Ceanothus verrucosus Nutt.1		UPL	UPL	UPL	UPL	UPL
Centaurea calcitrapa L.		UPL	UPL	UPL	UPL	UPL
Centaurea maculosa auct. non Lam.	*Centaurea stoebe* L. ssp. *micranthos* (Gugler) Hayek	UPL	UPL	UPL	UPL	UPL
Centaurea melitensis L.		UPL	UPL	UPL	UPL	UPL
Centaurium venustum (Gray) B.L. Robins.		UPL	UPL	UPL	UPL	UPL
Cercocarpus minutiflorus Abrams	*Cercocarpus montanus* Raf. var. *minutiflorus* (Abrams) F.L. Martin	UPL	UPL	UPL	UPL	UPL
Chenopodium leptophyllum (Moq.) Nutt. ex. S. Wats. 2		FACU	FACU	FACU	FACU	UPL
Chorizanthe watsonii Torr. & Gray		UPL	UPL	UPL	UPL	UPL
Chrysothamnus nauseosus (Pallas ex Pursh) Britt ssp. *albicaulis* (Nutt.) Hall & Clements 2,7	*Ericameria nauseosa* (Pallas ex Pursh) Nesom & Baird ssp. *nauseosa* var. *speciosa* (Nutt.) Nesom & Baird	UPL	UPL	UPL	UPL	UPL
Chrysothamnus teretifolius (Dur. & Hilg.) Hall 2	*Ericameria teretifolia* (Dur. & Hilg.) Jepson	UPL	UPL	UPL	UPL	UPL
Cirsium occidentale (Nutt.) Jepson		UPL	UPL	UPL	UPL	UPL
Cirsium vulgare (Savi) Ten.		FACU	FACU	FAC	FACU	FACU
Claytonia parviflora Dougl. ex Hook.		UPL	UPL	UPL	UPL	UPL
Conium maculatum L.		FACW	OBL	FACW	FACW-	FACW
Conyza canadensis (L.) Cronq. 1		UPL	FACU	UPL	FACU	FAC
Cortaderia jubata (Lem.) Stapf		UPL	UPL	UPL	UPL	UPL
Cotula coronopifolia L.		NO	OBL	NI	FACW+	FACW+
Crassula aquatica (L.) Schoenl. 2		OBL	OBL	NI	OBL	OBL
Cressa truxillensis Kunth 7		FACW-	FACW-	FACW	FACW	FACW
Croton californicus Muell.-Arg. 2		UPL	UPL	UPL	UPL	UPL
Croton pottsii (Klotzsch) Muell.-Arg.		UPL	UPL	UPL	UPL	UPL
Cryptantha circumscissa (Hook. & Arn.) I.M. Johnston		UPL	UPL	UPL	UPL	UPL
Cryptantha clevelandii Greene		UPL	UPL	UPL	UPL	UPL
Cryptantha intermedia (Gray) Greene		UPL	UPL	UPL	UPL	UPL
Cryptantha nevadensis A. Nels. & Kennedy		UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Cucurbita foetidissima Kunth		UPL	UPL	UPL	UPL	UPL
Cuscuta californica Hook. & Arn.		UPL	UPL	UPL	UPL	UPL
Cynara cardunculus L.		UPL	UPL	UPL	UPL	UPL
Cynodon dactylon (L.) Pers.		FACU+	FACU	FAC	FACU	FAC
Cyperus eragrostis Lam.		NO	NO	NO	NI	FACW
Cyperus alternifolius L.	*Cyperus involucratus* Rottb.	FACW+	NO	NO	NO	OBL
Cyperus odoratus L.		FACW	FACW+	NO	NO	FACW
Cytisus multiflorus (L'Hér.) Sweet		UPL	UPL	UPL	UPL	UPL
Deschampsia danthonioides (Trin.) Munro		NO	FACW-	FACW	FACW-	FACW
Datura stramonium L.		UPL	UPL	UPL	UPL	UPL
Descurainia pinnata (Walt.) Britt. 1		UPL	UPL	UPL	UPL	UPL
Distichlis spicata (L.) Greene 1,2,7		FACW+	FACW	FAC+*	FACW	FACW
Dudleya cymosa (Lem.) Britt. & Rose		UPL	UPL	UPL	UPL	UPL
Echinochloa crus-galli (L.) Beauv.		FACW-	FACW-	FACW	FACW	FACW
Echinochloa crus-pavonis (Kunth) J.A. Schultes var. *macera* (Wieg.) Gould		OBL	OBL	FACW	FACW	OBL
Echinochloa muricata (Beauv.) Fern.		FACW	FACW	FACW	FACW	FACW
Eleocharis macrostachya Britt.		OBL	OBL	OBL	OBL	OBL
Eleocharis montevidensis Kunth		FACW+	FACW	NO	NO	FACW
Eleocharis obtusa (Willd.) J.A. Schultes		OBL	OBL	OBL	OBL	OBL
Elymus cinereus Scribn. & Merr. 1,2	*Leymus cinereus* (Scribn. & Merr.) A. Löve	NO	NI	NI	NI	NI
Elymus glaucus Buckl.		NO	FACU	FACU	FACU	FACU
Elymus multisetus M.E. Jones		UPL	UPL	UPL	UPL	UPL
Encelia farinosa Gray ex Torr. 1,2, 7		UPL	UPL	UPL	UPL	UPL
Ephedra nevadensis S. Wats.2,7, 9		UPL	UPL	UPL	UPL	UPL
Epilobium canum (Greene) Raven		UPL	UPL	UPL	UPL	UPL
Epilobium ciliatum Raf.		FACU	FACW	FAC	FACW-	FACW
Erigeron foliosus Nutt.		UPL	UPL	UPL	UPL	UPL
Eriodictyon crassifolium Benth.		UPL	UPL	UPL	UPL	UPL
Eriogonum deflexum Torr.		UPL	UPL	UPL	UPL	UPL
Eriogonum fasciculatum Benth. 1		UPL	UPL	UPL	UPL	UPL
Eriogonum inflatum Torr. & Frém.		UPL	UPL	UPL	UPL	UPL
Eriophyllum confertiflorum (DC.) Gray 1, 2		UPL	UPL	UPL	UPL	UPL
Erodium botrys (Cav.) Bertol.		UPL	UPL	UPL	UPL	UPL
Erodium cicutarium (L.) L'Hér. ex Ait.		UPL	UPL	UPL	UPL	UPL
Eucalyptus globus Labill.		UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Eurotia lanata (Pursh) Moq.	*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse & Smit	UPL	UPL	UPL	UPL	UPL
Eustoma exaltatum (L.) Salisb. ex G. Don		FACW	OBL*	NO	NO	OBL*
Festuca arundinacea Schreb.	*Schedonorus phoenix* (Scop.) Holub	FAC-	NA*	FACW-	FACU-	FAC-
Festuca octoflora Walt. 1,2	*Vulpia octoflora* (Walt.) Rydb. var. *octoflora*	NI	NI	UPL	UPL	UPL
Festuca rubra L.		FAC*	FACW-	FAC	FAC	FAC
Foeniculum vulgare P. Mill.		FAC	FACU	FACU	FACU	FACU
Forestiera pubescens Nutt. var. *neomexicana* (Gray) E. Murr.	*Forestiera neomexicana* Gray	FAC-	FACU	FAC+	NO	FAC
Frankenia jamesii Torr. ex Gray		UPL	UPL	UPL	UPL	UPL
Fraxinus velutina Torr. 2,7		FAC	FAC+	FAC	NO	FACW
Galium angustifolium Nutt. ex Gray		UPL	UPL	UPL	UPL	UPL
Galium aparine L.		FAC-	FACU	FACU	FACU	FACU
Galium triflorum Michx.		FACU	FACU+	FACU	FACU	FACU
Geranium carolinianum L.		UPL	UPL	UPL	UPL	UPL
Geranium molle L.		UPL	UPL	UPL	UPL	UPL
Gilia latiflora (Gray) Gray		UPL	UPL	UPL	UPL	UPL
Gilia leptalea (Gray) Greene	*Navarretia leptalea* (Gray) L.A. Johnson	UPL	UPL	UPL	UPL	UPL
Gilia leptomeria Gray	*Aliciella leptomeria* (Gray) J.M. Porter	UPL	UPL	UPL	UPL	UPL
Gnaphalium beneolens A. Davids	*Pseudognaphalium canescens* (DC.) W.A. Weber ssp. *beneolens* (A. Davids.)	UPL	UPL	UPL	UPL	UPL
Gnaphalium californicum DC.	*Pseudognaphalium californicum* (DC.) A. Anderb.	UPL	UPL	UPL	UPL	UPL
Gnaphalium canescens DC.	*Pseudognaphalium canescens* (DC.) W.A. Weber ssp. *canescens*	UPL	UPL	FACU	NO	FACU*
Gutierrezia microcephala (DC.) Gray		UPL	UPL	UPL	UPL	UPL
Gutierrezia sarothrae (Pursh) Britt. & Rusby 1,2,7		UPL	UPL	UPL	UPL	UPL
Haplopappus acradenia (Gray) Blake 7	*Isocoma acradenia* (Greene) Greene	NO	NI	NI	NO	NI
Haplopappus cooperi (Gray) Hall 2	*Ericameria cooperi* (Gray) Hall	UPL	UPL	UPL	UPL	UPL
Helianthus annuus L.		FAC	FAC-	FACU	FACU+	FAC-
Heliotropium curassavicum L.		FACW	FACW*	OBL	OBL	OBL

Table 3 (cont.). Dry wash species.

Heliotropium curassavicum L. var. *oculatum* (Heller) I.M. Johnston 7		FACW	FACW*	OBL	OBL	OBL
Heteromeles arbutifolia (Lindl.) M. Roemer 1		UPL	UPL	UPL	UPL	UPL
Heterotheca grandiflora Nutt. 1		UPL	UPL	UPL	UPL	UPL
Hilaria mutica (Buckl.) Benth. 1	*Pleuraphis mutica* Buckl.	UPL	UPL	UPL	UPL	UPL
Hordeum leporinum L. ssp. *leporinum* (Link) Arcang.		NI	NI	NI	NI	NI
Hordeum murinum L.		NI	NI	NI	NI	NI
Hymenoclea monogyra Torr. & Gray ex Gray 1,7		UPL	UPL	UPL	UPL	UPL
Hymenoclea salsola Torr. & Gray ex Gray 1,2,7,9		UPL	UPL	UPL	UPL	UPL
Iris missouriensis Nutt.		NO	FACW-	OBL*	FACW+	OBL
Isocoma menziesii (Hook. & Arn.) Nesom		NO	NO	NO	NO	FACW*
Iva hayesiana Gray		NO	NO	NO	NO	FACW
Juncus actus L. 2		NO	FACW	FACW+	NO	FACW
Juncus balticus Willd.	*Juncus arcticus* Willd. ssp. *littoralis* (Engelm.) Hultén	NO	NO	FACW	NO	NO
Juncus dubius Engelm.		NO	NO	NI	NI	FACW*
Juncus mexicanus Willd. ex J.A. & J.H. Schultes		FACW	FACW	FACW	NO	FACW
Lactuca serriola L. 1		FAC	FAC	FACU	FAC-	FAC
Larrea divaricata auct. non Cav. 1,7	*Larrea tridentata* (Sessé & Moc. ex DC.) Coville var. *tridentata*	UPL	UPL	UPL	UPL	UPL
Lasthenia californica D.C. ex Lindl.		NO	UPL	NO	UPL	FACU*
Leman minor L.		OBL	OBL	OBL	OBL	OBL
Lepidium densiflorum Schrad.		FAC	FAC	FACU	FAC-	FAC
Lepidium fremontii S. Wats. 1,2,7		UPL	UPL	UPL	UPL	UPL
Lepidium latifolium L.		NO	NI	FAC	FAC	FACW
Lepidium virginicum L.		FAC-	UPL*	FACU	FACU	FACU
Lepidospartum squamatum (Forssk.) Aschers.		UPL	UPL	UPL	UPL	UPL
Lessingia lemmonii Gray		UPL	UPL	UPL	UPL	UPL
Limonium californicum (Boiss.) Heller		NO	NO	NO	NO	OBL
Limonium limbatum Small		FACW+	FACW	NO	NO	NO
Lolium multiflorum Lam.	*Lolium perenne* L. ssp. *multiflorum* (Lam.) Husnot	FACU	FACU	FACU	FACU	FAC*
Lolium perenne L.		FACU	FACU	FACU	FACU	FAC*
Lonicera subspicata Hook. & Arn		UPL	UPL	UPL	UPL	UPL
Lonicera japonica Thunb.		FAC	FACU*	FAC+	NO	NI

Table 3 (cont.). Dry wash species.

Lotus corniculatus L.		FAC	FACU+	NO	FAC	FAC
Lotus scoparius (Nutt.) Ottley 2		UPL	UPL	UPL	UPL	UPL
Lupinus bicolor Lindl.		UPL	UPL	UPL	UPL	UPL
Lycium cooperi Gray 2,7		UPL	UPL	UPL	UPL	UPL
Lygodesmia exigua (Gray) Rydb. 2		UPL	UPL	UPL	UPL	UPL
Lythrum hyssopifolia L.		NO	NO	NO	OBL	FACW
Machaeranthera pinnatifida (Hook.) Shinners		UPL	UPL	UPL	UPL	UPL
Macheranthera tortifolia (Torr. & Gray) Cronq. & Keck 2,9	*Xylorhiza tortifolia* (Torr. & Gray) Greene var. *tortifolia*	UPL	UPL	UPL	UPL	UPL
Marah macrocarpus (Greene) Greene 2		UPL	UPL	UPL	UPL	UPL
Marrubium vulgare L.		FACW-	FAC+	FACU	FACU+	FAC
Matricaria matricarioides (Less.) T. Porter	*Matricaria discoidea* DC.	UPL*	FACU	FACU	FACU	FACU
Medicago polymorpha L.		UPL	UPL	UPL	UPL	UPL
Medicago sativa L.		UPL	UPL	UPL	UPL	UPL
Melilotus alba Medik.	*Melilotus officinalis* (L.) Lam.	FACU	FACU+	FACU	FACU	FACU+
Melilotus indica (L.) All.		FACU	FACU+	FACU	FACU	FAC
Melilotus officinalis (L.) Lam.		FACU	FACU+	FACU	FACU	FACU
Mentha arvensis L.		FACW	FACW	FACW	FAC	FACW
Mentha spicata L.		FACW	FACW*	FACW	OBL	OBL
Mentzelia albicaulis (Dougl. ex Hook.) Dougl. ex Torr. & Gray		UPL	UPL	UPL	UPL	UPL
Mimulus aurantiacus W. Curtis 2	*Diplacus aurantiacus* (W. Curtis) Jepson ssp. *aurantiacus*	UPL	UPL	UPL	UPL	UPL
Mimulus guttatus DC.		NO	OBL	OBL	OBL	OBL
Muhlenbergia porteri Scribn. ex Beal 1,2		UPL	UPL	UPL	UPL	UPL
Muhlenbergia rigens (Benth.) A.S. Hitchc.		FACU*	FACU*	UPL	NO	FACW
Najas guadalupensis (Spreng.) Magnus		OBL	OBL	OBL	OBL	OBL
Nassella lepida (A.S. Hitchc.) Barkworth		UPL	UPL	UPL	UPL	UPL
Nasturtium officinale Ait. F.		OBL	OBL	OBL	OBL	OBL
Nicotiana glauca (S. Wats.) S. Wats.		FAC	FAC	NI	NO	FAC
Oenothera californica (S. Wats.) S. Wats.		UPL	UPL	UPL	UPL	UPL
Opuntia bigelovii Engelm. 2	*Cylindropuntia bigelovii* (Engelm.) F.M. Knuth	UPL	UPL	UPL	UPL	UPL
Opuntia littoralis (Engelm.) Cockerell		UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Opuntia phaeacantha Engelm. var. *discata* (Griffiths) L. Benson & Walkington 1	*Opuntia engelmannii* Salm-Dyck ex Engelm.	UPL	UPL	UPL	UPL	UPL
Opuntia ramosissima Engelm 1,2	*Cylindropuntia ramosissima* (Engelm.) F.M. Knuth	UPL	UPL	UPL	UPL	UPL
Orthocarpus luteus Nutt.		NO	FACU-	FACU	FACU-	FACU
Oryzopsis hymenoides (Roemer & J.A. Schultes) Ricker ex Piper 1,2, 9	*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barkworth	FACU+	FACU-	UPL	UPL	UPL
Oxalis albicans Kunth		UPL	UPL	UPL	UPL	UPL
Dichanthelium acuminatum (SW.) Gould & C.A. Clark		FAC	FAC	FACW	FAC	FACW
Panicum capillare L.		FAC	FAC	FACU	FAC	FAC
Panicum dichotomiflorum Michx.		FACW	FAC	FACW	FACW	FACW
Panicum hallii Vassey		FACU	FACU	UPL	NO	NO
Paspalum dilatatum Poir.		FAC	FAC	NO	NI	FAC
Pennisetum setaceum (Forssk.) Chiov.		UPL	UPL	UPL	UPL	UPL
Petalonyx thurberi Gray 1,7		UPL	UPL	UPL	UPL	UPL
Petroselinum crispum (P. Mill.) Nyman ex A.W. Hill		UPL	UPL	UPL	UPL	UPL
Phacelia tanacetifolia Benth.		UPL	UPL	UPL	UPL	UPL
Phalaris arundinacea L.		FACW+	OBL	OBL	FACW	OBL
Phleum pratense L.		FACU	FACU	FACU	FACU	FACU
Phytolacca americana L.		FAC-	NI	NO	NI	NI
Picris echioides L.		NO	NO	NO	NO	FAC*
Pinus coulteri D. Don 1		UPL	UPL	UPL	UPL	UPL
Plagiobothrys bracteatus (T.J. Howell) I.M. Johnston		NO	NO	NO	FACW+	OBL
Plantago elongata Pursch		FACW-	NO	FACW	FACW	FACW*
Plantago erecta Morris		UPL	UPL	UPL	UPL	UPL
Plantago lanceolata L.		FAC	FAC	FACU	FACU+	FAC-
Plantago major L.		FAC+	FACW	FAC	FAC+	FACW-
Plantanus racemosa Nutt. 7		NO	NO	NO	NO	FACW
Pluchea odorata (L.) Cass.		NO	NO	NO	NO	NO
Pluchea purpurascens (Sw.) DC.	*Pluchea odorata* (L.) Cass.	NO	NO	NO	NO	NO
Pluchea sericea (Nutt.) Coville 1,2,7, 10		NO	NI	FACW-	FACW	NO
Poa annua L.		FAC	FAC-	FAC	FAC-	FACW-
Poa glauca Vahl var. *rupicola* (Nash ex Rydb.) Boivin	*Poa glauca* Vahl ssp. *rupicola* (Nash ex Rydb.) W.A. Weber	UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Poa pratensis L.		FACU+	FACU	FACU	FACU+	FACU
Poa secunda J. Presl 2		UPL	UPL	UPL	UPL	UPL
Polygonum lapathifolium L.		FACW-	OBL	OBL	FACW+	OBL
Polygonum punctatum Ell.		FACW	OBL	OBL	OBL	OBL
Polypogon monpeliensis (L.) Desf.		FACW+	FACW+	FACW+	FACW+	FACW+
Polystichum imbricans (D.C. Eat.) D.H. Wagner		UPL	UPL	UPL	UPL	UPL
Populus fremontii S. Wats. 1,2,5,7		FACW-	FACW	FACW*	NO	FACW
Populus tremula L. 7		FAC-	FACU	FAC	FAC+	FAC+
Portulaca oleracea L.		FAC	FAC	FAC	FAC	FAC
Prosopis glandulosa Torr.1,2,7		UPL	UPL	UPL	UPL	UPL
Pseudoclappia arenaria Rydb.		UPL	UPL	UPL	UPL	UPL
Pteridium aquilinum (L.) Kuhn		FAC-	FACU	FACU	FACU	FACU
Quercus agrifolia Née 1		UPL	UPL	UPL	UPL	UPL
Quercus chrysolepis Liebm. 1,2,7		UPL	UPL	UPL	UPL	UPL
Quercus dumosa Nutt. 1,2		UPL	UPL	UPL	UPL	UPL
Rhus integrifolia (Nutt.) Benth. & Hook. f. ex Brewer & S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Rhus ovata S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Ribes speciosum Pursh		UPL	UPL	UPL	UPL	UPL
Ricinus communis L.		FACU	FAC-	NI	NO	FACU
Rorippa nasturium-aquaticum (L.) Hayek 2	*Nasturtium officinale* Ait. f.	OBL	OBL	OBL	OBL	OBL
Rosa californica Cham. & Schlecht.		NO	NO	NO	NI	FAC+
Rudbeckia californica Gray		NO	NO	NO	FACU+	FACW
Rumex crispus L.		FACW	FACW	FACW	FACW	FACW-
Rumex hymenosepalus Torr.		UPL	UPL	UPL	UPL	UPL
Salicornia utahensis Tidestrom 1	*Sarcocornia utahensis* (Tidestrom) A.J. Scott	FACW*	FACW	OBL	NO	OBL
Salicornia virginica L.	*Salicornia depressa* Standl.	OBL*	OBL	NO	OBL	OBL
Salix exigua Nutt. 7		FACW+	OBL	OBL	OBL	OBL
Salix gooddingii Ball 1,2,5,7		FACW+	OBL	FACW	NO	OBL
Salix laevigata Bebb 7		UPL	UPL	UPL	UPL	UPL
Salix lasiolepis Benth. 7		FACW	FACW	FACW	FACW	FACW
Salsola tragus L.		FACU	FACU	FACU	FACU	FACU
Salsola kali L. 1		FACU	FACU	FACU	UPL	FACU+
Salvia apiana Jepson		UPL	UPL	UPL	UPL	UPL
Salvia carduacea Benth.		UPL	UPL	UPL	UPL	UPL
Salvia columbariae Benth. 2		UPL	UPL	UPL	UPL	UPL
Salvia mellifera Greene 2		UPL	UPL	UPL	UPL	UPL

Table 3 (cont.). Dry wash species.

Sambucus mexicanus K. Presl ex DC. ssp. *cerulea* (Raf.) E. Murr.	*Sambucus nigra* L. ssp. *canadensis* (L.) R. Bolli	FAC	FAC	FACU	NO	FAC
Samolus ebracteatus Kunth		FACW*	OBL	NI	NO	NO
Sanicula crassicaulis Poepp. ex DC.		UPL	UPL	UPL	UPL	UPL
Sarcobatus vermiculatus (Hook.) Torr. 1,2		FACU+	FACU+	FACU*	FACU+	FACU
Schismus barbatus (Loefl. ex L.) Thellung 2		UPL	UPL	UPL	UPL	UPL
Scirpus acutus Muhl. Ex Bigelow	*Schoenoplectus acutus* var. *acutus* (Muhl. ex Bigelow) A.& D. Löve	OBL	OBL	OBL	OBL	OBL
Scirpus americanus (Pers.) Volk. ex Schinz & R. Keller		OBL	OBL	OBL	OBL	OBL
Scirpus californicus (C.A. Mey.) Palla		OBL	OBL	NO	NO	OBL
Scirpus cernuus (Vahl) Roemer & J.A. Schultes		NO	NO	NO	OBL	OBL
Scirpus microcarpus J. & K. Presl		NO	OBL	OBL	OBL	OBL
Scirpus robustus Pursh	*Schoenoplectus robustus* (Pursh) M.T. Strong	OBL	NO	NO	NO	OBL
Scrophularia californica Cham. & Schlecht.		NO	FACW-	NO	FACW-	FAC
Senecio vulgaris L.		NI	NI	UPL	FACU	NI*
Sesuvium verrucosum Raf. 1,7		FACW-	FACW	FACW+	NI	FACW
Setaria glauca (L.) Beauv.	*Setaria pumila* (Poir.) Roemer & J.A. Schultes ssp. pumila	FAC	FAC	FACU	FAC	FAC
Setaria viridis (L.) Beauv.		UPL	UPL	UPL	UPL	UPL
Sisymbrium altissimum L. 2		FACU+	FAC	FACU-	FACU-	FACU
Sisyrinchium bellum S. Wats.		NO	NO	NO	FACW-	FAC
Sitanion hystrix (Nutt.) J.G.Smith 1,2	*Elymus elymoides* (Raf.) Swezey	FACU-	UPL	UPL	FACU-	FACU
Solanum elaeagnifolium Cav.		UPL	UPL	UPL	UPL	UPL
Solanum parishii Heller		UPL	UPL	UPL	UPL	UPL
Solidago californica Nutt.		UPL	UPL	UPL	UPL	UPL
Solidago spectabilis (D.C. Eat.) Gray var. *confinis* (Gray) Cronq.		NO	NO	NI	NO	FAC
Sonchus arvensis L.		NI	NI	FACU	FACU+	FACU
Sonchus apser (L.) Hill		FAC-	FACW	FACU	FAC-	FAC
Sonchus oleraceus L.		UPL*	UPL*	UPL	UPL	NI*
Sporobolus airoides (Torr.) Torr. 1,2		FAC	FAC	FAC	FAC-	FAC+
Sporobolus contractus A.S. Hitchc.		UPL	UPL	UPL	UPL	UPL
Sporobolus wrightii Munro ex Scribn.		UPL	UPL	UPL	UPL	UPL
Stachys ajugoides Benth.		NO	NO	NO	NO	OBL

Table 3 (cont.). Dry wash species.

Stephanomeria exigua Nutt.		UPL	UPL	UPL	UPL	UPL
Stipa speciosa Swallen 2	*Achnatherum diegoense* (Swallen) Barkworth	NO	NO	NO	NO	FACW*
Achnatherum speciosum (Trin. & Rupr.) Barkworth		UPL	UPL	UPL	UPL	UPL
Streptanthella longirostris (S. Wats.) Rydb.		UPL	UPL	UPL	UPL	UPL
Suaeda moquinii (Torr.) Greene		NO	FACW	FACW	FACW	NO
Suaeda suffrutescens S. Wats.		OBL	OBL	NO	NO	NO
Tamarix parviflora DC. 7		FACW	NI	FACW	NI	FAC
Tamarix ramosissima Ledeb. 7		FACW	NI	FACW	FACW	FAC
Taraxacum officinale G.H. Weber ex Wiggers		FACU+	FACU	FACU+	FACU	FACU
Toxicodendron diversilobum (Torr. & Gray) Greene		UPL	UPL	UPL	UPL	UPL
Trifolium repens L.		FACU+	NI	FACU	FACU+	FACU+
Typha angustifolia L. 7		OBL	NI	OBL	OBL	OBL
Typha latifolia L. 7		OBL	OBL	OBL	OBL	OBL
Urtica dioica L.		FAC	NI	FAC	FAC+	FACW
Verbesina encelioides (Cav.) Benth. & Hook. f. ex Gray		FAC	FAC	FACU	NO	FAC
Veronica americana Schwein. ex Benth.		NI	OBL	OBL	OBL	OBL
Veronica anagallis-aquatica L.		OBL	OBL	OBL	OBL	OBL
Veronica peregrina L.		OBL	OBL	FACW+	OBL	OBL
Vicia americana Muhl. ex Willd.		NI	NI	NI	NI	NI
Vicia cracca L.		UPL	UPL	UPL	UPL	UPL
Vitis californica Benth.		NO	NI	NO	FACU	FACW
Vitis girdiana Munson		UPL	UPL	UPL	UPL	UPL
Vulpia myuros (L.) K.C. Gmel.		FAC	FACW	FACW-	FAC	FACU*
Washingtonia filifera (L. Linden) H. Wendl. 2,7		NO	FACW	NO	NO	FACW
Xanthium strumarium L.		FAC-	NI	FAC	FAC	FAC+
Yucca brevifolia Engelm.		UPL	UPL	UPL	UPL	UPL

1 Barbour and Billings (1988)
2 Barbour and Major (1977)
3 Hunt (1966)
4 Hunt (1975)
5 Scott et al. (2000)
6 Stone (1956)
7 Thorne (1976)
8 Vasek (1983)
9 Wallace et al. (1980)
10 Went and Westergaard (1949)
11 West (1983)
12 Wondzell et al. (1990)

Dry Wash Phreatophytes

Dry wash phreatophytes (Table 3) can be found along intermittent and ephemeral watercourses and in depressions where the stored water or water table is near the surface in arid riparian habitats. They are generally limited to areas where there is a permanent undergroundwater supply. This adaptation enables them to avoid the rigors of the arid environment by having roots in constant contact with the fringe of capillary water above a water table (Hunt 1966). Because of their deep rooting system, desert phreatophytes have low water stress tolerance and high water stress avoidance (Nilsen et al. 1984). These species, known as obligate phreatophytes, are usually limited to the narrow, gallery forest directly adjacent to the channel that is dominated by cottonwood (*Populus* spp.) willows *(Salix* spp.), and mesquite (*Prosopis* spp.) species (Scott et al. 2000, Lichvar and Sprecher 1996). Other species are able to take advantage of groundwater when present but can also tolerate periods of low water availability. These facultative phreatophytes occur where water and salts accumulate (Barbour et al. 1987). Dry wash phreatophytes have several mechanisms to avoid drought, especially in the summer when it is the hottest and driest; these include deciduousness and a very low stomatal conductance (Nilsen et al. 1984). Table 4 lists 62 dry wash phreatophytes.

Table 4. Dry wash phreatophytes.

1988 synonymy	Current name	Region 6	Region 7	Region 8	Region 9	Region 0
Adenostoma fasciculatum Hook. & Arn. 1,2		UPL	UPL	UPL	UPL	UPL
Adenostoma sparsifolium Torr. 1,2		UPL	UPL	UPL	UPL	UPL
Allenrolfea occidentalis (S. Wats.) Kuntze 2,3		FACW	FACW	FACW	FACW+	FACW+
Ambrosia dumosa (Gray) Payne 2		UPL	UPL	UPL	UPL	UPL
Atriplex canescens (Pursh) Nutt. 2, 3		UPL	UPL	UPL	UPL	FACU
Atriplex confertifolia (Torr. & Frém.) S. Wats. 1,2,7,10		UPL	UPL	UPL	UPL	UPL
Atriplex hymenelytra (Torr.) S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Atriplex parryi S. Wats. 1		NO	NO	FACW	NO	FACW
Atriplex polycarpa (Torr.) S. Wats. 1,2		NO	FACU-	FACU	NO	FACU
Atriplex spinifera J.F. Macbr. 1		NO	NO	NO	NO	FAC
Baccharis pilularis DC. 1		UPL	UPL	UPL	UPL	UPL
Baccharis salicifolia (Ruiz & Pavón) Pers.		NI	FACW	FACW	NO	FACW

Table 4 (cont.). Dry wash phreatophytes.

Baccharis sarothroides Gray 2,7		NO	FAC-	NI	NO	FAC
Baccharis viminea DC. 1	*Baccharis salicifolia* (Ruiz & Pavón) Pers.	NI	FACW	FACW	NO	FACW
Ceanothus crassifolius Torr. 1		UPL	UPL	UPL	UPL	UPL
Ceanothus cuneatus (Hook.) Nutt. 1,2		UPL	UPL	UPL	UPL	UPL
Ceanothus greggii Gray 1,2,7		UPL	UPL	UPL	UPL	UPL
Ceanothus tomentosus Parry 1,2		UPL	UPL	UPL	UPL	UPL
Ceanothus verrucosus Nutt. 1		UPL	UPL	UPL	UPL	UPL
Chrysothamnus nauseosus (Pallas ex Pursh) Britt ssp. *albicaulis* (Nutt.) Hall & Clements 2,7	*Ericameria nauseosa* (Pallas ex Pursh) Nesom & Baird ssp. *nauseosa* var. *speciosa* (Nutt.) Nesom & Baird	UPL	UPL	UPL	UPL	UPL
Encelia farinosa Gray ex Torr. 1,2,7		UPL	UPL	UPL	UPL	UPL
Eriogonum fasciculatum Benth 1		UPL	UPL	UPL	UPL	UPL
Eriogonum inflatum Torr. & Frém. 2,7		UPL	UPL	UPL	UPL	UPL
Eucalyptus globulus Labill.		UPL	UPL	UPL	UPL	UPL
Frankenia jamesii Torr. ex Gray		UPL	UPL	UPL	UPL	UPL
Fraxinus velutina Torr.		FAC	FAC+	FAC	NO	FACW
Gutierrezia microcephala (DC.) Gray		UPL	UPL	UPL	UPL	UPL
Gutierrezia sarothrae (Pursh) Britt. & Rusby 1,2,7		UPL	UPL	UPL	UPL	UPL
Haplopappus acradenius (Greene) Blake 7	*Isocoma acradenia* (Greene) Greene	NO	NI	NI	NO	NI
Haplopappus cooperi (Gray) Hall 2	*Ericameria cooperi* (Gray) Hall	UPL	UPL	UPL	UPL	UPL
Heterotheca grandiflora Nutt. 1		UPL	UPL	UPL	UPL	UPL
Hymenoclea monogyra Torr. & Gray ex Gray 1,7		UPL	UPL	UPL	UPL	UPL
Hymenoclea salsola Torr. & Gray ex Gray 1,2,7,9		UPL	UPL	UPL	UPL	UPL
Isocoma menziesii (Hook. & Arn.) Nesom		NO	NO	NO	NO	FACW*
Lepidium latifolium L.		NO	NI	FAC	FAC	FACW
Lepidospartum squamatum (Forssk.) Aschers.		UPL	UPL	UPL	UPL	UPL
Lotus scoparius (Nutt.) Ottley 2		UPL	UPL	UPL	UPL	UPL
Petalonyx thurberi Gray 1,7		UPL	UPL	UPL	UPL	UPL
Plantanus racemosa Nutt. 7		NO	NO	NO	NO	FACW
Pluchea odorata (L.) Cass.		NO	NO	NO	NO	NO
Pluchea purpurascens (Sw.) DC.	*Pluchea odorata* (L.) Cass.	NO	NO	NO	NO	NO
Pluchea sericea (Nutt.) Coville 3		NO	NI	FACW-	FACW	NO

Table 4 (cont.). Dry wash phreatophytes.

Populus fremontii S. Wats. 1,2,5,7		FACW-	FACW	FACW*	NO	FACW
Prosopis glandulosa Torr. 1,2,7		UPL	UPL	UPL	UPL	UPL
Quercus agrifolia Née 1		UPL	UPL	UPL	UPL	UPL
Quercus chrysolepis Liebm. 1,2,7		UPL	UPL	UPL	UPL	UPL
Quercus dumosa Nutt. 1,2		UPL	UPL	UPL	UPL	UPL
Rhus integrifolia (Nutt.) Benth. & Hook. f. ex Brewer & S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Rhus ovata S. Wats. 1,2		UPL	UPL	UPL	UPL	UPL
Ribes speciosum Pursh		UPL	UPL	UPL	UPL	UPL
Salix exigua Nutt. 7		FACW+	OBL	OBL	OBL	OBL
Salix gooddingii Ball 1,2,5,7		FACW+	OBL	FACW	NO	OBL
Salix laevigata Bebb 7		UPL	UPL	UPL	UPL	UPL
Salix lasiolepis Benth. 7		FACW	FACW	FACW	FACW	FACW
Salsola kali L. 1		FACU	FACU	FACU	FACU	FACU+
Suaeda moquinii (Torr.) Greene		NO	FACW	FACW	FACW	NO
Suaeda suffrutescens S. Wats. 3		OBL	NO	NO	NO	
Tamarix parviflora DC. 2		FACW	NI	FACW	NI	FAC
Tamarix ramosissima Ledeb 2.		FACW	NI	FACW	FACW	FAC
Washingtonia filifera (L. Linden) H. Wendl. 2,7		NO	FACW	NO	NO	FACW
Xanthium strumarium L.		FAC-	NI	FAC	FAC	FAC+
Yucca brevifolia Engelm. 1,2,7		UPL	UPL	UPL	UPL	UPL

1 Barbour and Billings (1988)
2 Barbour and Major (1977)
3 Hunt (1966)
4 Hunt (1975)
5 Scott et al. (2000)
6 Stone (1956)
7 Thorne (1976)
8 Vasek (1983)
9 Wallace et al. (1980)
10 Went and Westergaard (1949)
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Hygro-halophytes

Hygro-halophytes are plant species found growing in desert lowlands under naturally saline conditions where water occurs within 1 m of the surface and is occasionally found at the surface (West 1983). In many locations, water occurs within 1 m of the surface as a result of mountain precipitation that has infiltrated into the headwaters of the aquifer where it enters the regional groundwater aquifer and flows down to the center of the basin or wash (West 1983). Here the groundwater table can intersect the ground surface and provide base flow to streams and water for vegetation (Scott et al. 2000). Hygro-halophytes can be found in dry washes where the groundwater table is near the surface and along the playa edges. The roots of these species do not usually reach down to a permanent groundwater source; therefore, most species have adapted more of a fibrous-like root system, allowing them to obtain water at or near the surface. An example of a hygro-halophtye is iodinebush (*Allenrolfea occidentalis*), one of the most salt-tolerant plants in the desert, located in dry washes and around playa edges. *A. occidentalis* is found on salt-crusted silty faces of carbonate soils. This species also occurs on saline flats where the ground is covered by a coating of salt in blister-like augmentation that is 2.54–5.08 cm (1–2 in.) high and 15.24–30.48 cm (6–12 in.) wide. This crust can contain up to 20% water-soluble salts and has the ability to retain moisture for long periods of time following a rain event (Hunt 1966). Adaptations of hygro-halophytes include postponing their major development until the warmest part of the year, when they are "sub-irrigated" by the snowmelt from the mountains and the runoff into the basins, resulting in delayed leaf growth that causes species to take on a greenish cast until summer (West 1983). In addition to delayed leaf growth, hygro-halophytes have developed mechanisms for salt tolerance and avoidance. The list of 32 of hygro-halophytic species is provided in Table 5.

Table 5. Hygro-halophytic species.

1988 synonymy	Current name	Region 6	Region 7	Region 8	Region 9	Region 0
Allenrolfea occidentalis (S. Wats.) Kuntze 1,2,7, 10,11		FACW	FACW	FACW	FACW+	FACW+
Aster frondosus (Nutt.) Torr.& Gray 7	*Symphyotrichum frondosum*	NO	NI	OBL	FACW+	OBL
Baccharis sergiloides Gray 7		NO	FAC-	FACU	NO	FAC
Baccharis salicifolia (Ruiz & Pavón) Pers. 3,7		FACW	FACW	FACW	NO	FACW-
Chrysothamnus paniculatus (Gray) Hall 7	*Ericameria paniculata* (Gray) Rydb.	UPL	UPL	UPL	UPL	UPL
Cordylanthus canescens Gray 7	*Cordylanthus maritimus* Nutt. ex Benth. ssp. *canescens* (Gray) Chuang & Heckard	NO	NO	OBL	OBL	OBL
Cressa truxillensis Kunth 7		FACW-	FACW-	FACW	FACW	FACW
Distichlis spicata (L.) Greene 7		FACW+	FACW	FAC+*	FACW	FACW
Hemizonia pungens (Hook. & Arn.) Torr. & Gray 7	*Centromadia pungens* (Hook. & Arn.) Greene ssp. *pungens*	NO	FACW+	FAC	UPL	FAC
Juncus cooperi Engelm. 7, 10		NO	FACW	FACW+	NO	FACW
Juncus mexicanus Willd. ex J.A. & J.H. Schultes 7		FACW	FACW	FACW	NO	FACW

Table 5 (cont.). Hygro-halophytic species.

Limonium limbatum Smal		FACW+	FACW	NO	NO	NO
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi 7		FACW	FACW	FACW+	FACW	FACW
Nitrophila occidentalis (Moq.) S. Wats 2		NO	FAC+	FACW	FACW	FACW
Salicornia utahensis Tidestrom 2	*Sarcocornia utahensis* (Tidestrom) A.J. Scott	FACW*	FACW	OBL	NO	OBL
Salicornia subterminalis Parish 1, 11	*Arthrocnemum subterminale* (Parish) Standl.	NO	NO	NO	NO	OBL
Sesuvium verrucosum Raf. 7		FACW-	FACW	FACW+	NI	FACW
Sporobolus airoides (Torr.) Torr 1, 7		FAC	FAC	FAC	FAC-	FAC+
Sarcobatus vermiculatus (Hook.) Torr. 2		FACU+	FACU+	FACU*	FACU+	FACU
Scirpus americanus (Pers.) Volk. ex Schinz & R. Keller		OBL	OBL	OBL	OBL	OBL
Scirpus californicus (C.A. Mey.) Palla		OBL	OBL	NO	NO	OBL
Scripus olneyi Gray 2, 7	*Schoenoplectus americanus* (Pers.) Volk. ex Schinz & R. Keller	OBL	OBL	OBL	OBL	OBL
Scripus paludosus L. 7	*Schoenoplectus maritimus* (L.) Lye	NI	NI	NI	OBL	OBL
Scirpus nevadensis S. Wats. 7		NO	NO	OBL	OBL	OBL
Suaeda depressa (Pursh)S. Wats. 1,2	*Suaeda calceoliformis* (Hook.) Moq.	FACW-	FACW	FACW	FACW-	FACW+
Suaeda moquinii (Torr.) Greene		NO	FACW	FACW	FACW	NO
Suaeda nigra J.F. Macbr. 2	*Suaeda moquinni* (Torr.) Greene	NO	FACW	FACW	FACW	NO
Suaeda suffrutescens S. Wats. 3		OBL	OBL	NO	NO	NO
Suaeda torreyana S. Wats. 1,2,7	*Suaeda moquinni* (Torr.) Greene	FACW-	FAC	FAC+	FAC	FAC+
Triglochin maritima L. 2		NO	OBL	OBL	OBL	OBL
Typha latifolia L. 7		OBL	OBL	OBL	OBL	OBL
Typha anugustifolia L. 7		OBL	NI	OBL	OBL	OBL

1 Barbour and Billings (1988)
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5 Scott et al. (2000)
6 Stone (1956)
7 Thorne (1976)
8 Vasek (1983)
9 Wallace et al. (1980)
10 Went and Westergaard (1949)
11 West (1983)
12 Wondzell et al. (1990)

Xero-halophytes

Xero-halophytes are located within dry saline habitats. These habitats are formed inside high-evaporation basins and lowlands of the desert topography. Within this area, xero-halophytes can be found growing in soils with salt concentrations up to 6% and a water table well below 1 m (Barbour and Billings 1988). Xero-halophytes do not have root systems like phreatophytes that can extend to the water table; they typically do not even extend to the top of the capillary fringe. Instead, they have a shallow root system that allows them to obtain water from rains, dews, and vadose water. Vadose water is the major source of water that is used to sustain xero-halophytes, and the availability has been correlated with many distribution patterns (Hunt 1966). Beyond the edge of a playa, xero-halophyte patches increase in size and density, but at the edge of the playa, intermittent patches are found on soil mounds (Barbour and Major 1977). These occurrences at the playa edge result from gravel fans extending from the mountains to the edge of the playa, providing an optimal habitat where the water table is deep and xero-halophytes are able to thrive in the dry environment (Hunt 1966).

To adapt to the dry conditions, many xero-halophytes have a set of larger leaves that are lost as soil conditions become severely dry; in addition, they develop a second set of smaller over-wintering leaves that photosynthesize through the winter (West 1983). Other adaptations include vesiculated trichomes (bladder-like tips of leaf cells that recycle salt back to the environment) (Mozafar and Goodin 1970) to deal with high concentrations of salt and succulent leaves to allow for greater water storage (Gibson 1996). Glenn and Brown (1998) noted that the salts in the soil actually enhance the performance of seedlings in the dry and salty soil; this is contrary to the previous idea that these conditions were stress factors. Soil salts help xero-halophytes survive by lowering the leaf surface-to-area ratio and growth rate, decreasing the rate at which soil water is depleted and in return giving the species a longer life span (Glenn and Brown 1998). There are 47 species listed for xero-halophytes in Table 6.

Table 6. Xero-halophytic species.

1988 synonymy	Current name	Region 6	Region 7	Region 8	Region 9	Region 0
Ambrosia dumosa (Gray) Payne 2, 9		UPL	UPL	UPL	UPL	UPL
Artemisia arbuscula Nutt. 2,7		UPL	UPL	UPL	UPL	UPL
Artemisia spinescens D.C. Eat. 1,2,7	*Picrothamnus desertorum* Nutt.	UPL	UPL	UPL	UPL	UPL

Table 6 (cont.). Xero-halophytic species.

Artemisia tridentata Nutt. 1, 7		UPL	UPL	UPL	UPL	UPL
Atriplex canescens (Pursh) Nutt. 1,2,7		UPL	UPL	UPL	UPL	FACU
Atriplex confertifolia (Torr. & Frém.) S. Wats. 1,2, 7, 10,11		UPL	UPL	UPL	UPL	UPL
Atriplex corrugata S. Wats. 1,7,11		UPL	UPL	UPL	UPL	UPL
Atriplex cuneata A. Nels. 1,7,11		UPL	UPL	UPL	UPL	UPL
Atriplex falcata (M.E. Jones) Standl. 1, 7, 11		NO	NO	FACW*	UPL	FAC*
Atriplex hymenelytra (Torr.) S. Wats. 2, 3,7, 10		UPL	UPL	UPL	UPL	UPL
Atriplex polycarpa (Torr.) S. Wats. 2,3,7		NO	FACU-	FACU	NO	FACU
Atriplex gardneri (Moq.) D. Dietr 1,7,11		UPL	UPL	UPL	UPL	UPL
Atriplex parryi S. Wats. 2,7		NO	NO	FACW	NO	FACW
Atriplex polycarpa (Torr.) S. Wats. 2,3,7		NO	FACU-	FACU	NO	FACU
Atriplex spinosa (Hook.) Collotzi 1,7,11	*Grayia spinosa* (Hook.) Moq.	UPL	UPL	UPL	UPL	UPL
Atriplex tridentata Kuntze 1,7		NO	NO	FACW	NI	NO
Baccharis viminea DC. 1	*Baccharis salicifolia* (Ruiz & Pavón) Pers	NO	NI	FACW	FACW	NO
Bromus tectorum L. 1,11		UPL	UPL	UPL	UPL	UPL
Ceratoides lanata (Pursh) J.T. Howell 1,7,9,10,11	*Krascheninnikovia lanata* (Pursh) A.D.J. Meeuse & Smit	UPL	UPL	UPL	UPL	UPL
Chrysothamnus nauseosus (Pallas ex Pursh) Britt ssp. *arenarius* L.C. Anders. 2,7	*Ericameria nauseosus* (Pallas ex Pursh) Nesom & Baird ssp. *consimilis* (Greene) Nesom & Baird var. *mohavensis* (Greene) Nesom & Baird	UPL	UPL	UPL	UPL	UPL
Coleogyne ramosissima Torr. 2,7		UPL	UPL	UPL	UPL	UPL
Elymus cinereus Scribn. & Merr. 1, 11	*Leymus cinereus* (Scribn. & Merr.) A. Löve	NO	NI	NI	NI	NI
Encelia farinosa Gray ex Torr. 2,3,7		UPL	UPL	UPL	UPL	UPL
Eriogonum inflatum Torr. & Frém. 2,7		UPL	UPL	UPL	UPL	UPL
Euphorbia prostrata Ait. 3	*Chamaesyce prostrata* (Ait.) Small	UPL	UPL	UPL	UPL	UPL
Grayia spinosa (Hook.) Moq. 2,7,9		UPL	UPL	UPL	UPL	UPL
Halogeton glomeratus (Bieb.) C.A. Mey.1, 11		UPL	UPL	UPL	UPL	UPL
Hymenoclea salsola Torr. & Gray ex Gray 3,7,9		UPL	UPL	UPL	UPL	UPL

Table 6 (cont.). Xero-halophytic species.

Kochia american S. Wats. 1, 11	*Bassia american* (S. Wats.) A.J. Scott	FAC-	FAC	FACU	FACU	FAC+
Larrea tridentata (Sessé & Moc. ex DC.) Coville 2,3,7,9		UPL	UPL	UPL	UPL	UPL
Lepidum perfoliatum L. 1,11		FAC	UPL*	FACU-	FACU+	FACU
Lycium andersonii Gray 2,7, 9		UPL	UPL	UPL	UPL	UPL
Menodora spinescens Gray 2,7		UPL	UPL	UPL	UPL	UPL
Oryzopsis hymenoides (Roemer & J.A. Schultes) Ricker ex Piper 2,11	*Achnatherum hymenoides* (Roemer & J.A. Schultes) Barkworth	FACU+	FACU-	UPL	UPL	UPL
Purshia glandulosa Curran 2,7		UPL	UPL	UPL	UPL	UPL
Purshia tridentata (Pursh) DC. 2,7		UPL	UPL	UPL	UPL	UPL
Salsola kali L.1, 11		FACU	FACU	FACU	UPL	FACU+
Sitanion hystrix (Nutt.) J.G. Sm 1, 11	*Elymus elymoides* (Raf.) Swezey	FACU-	UPL	UPL	FACU-	FACU
Sphaeralcea ambigua Gray 2,7		UPL	UPL	UPL	UPL	UPL
Suaeda fruticosa auct. non Forssk 1	*Suaeda moquinii* (Torr.) Greene	FACW-	FAC	FAC+	FAC	FAC+
Suaeda suffrutescens S. Wats. 3		OBL	OBL	NO	NO	NO
Tetradymia axillaris A. Nels. 2,7		UPL	UPL	UPL	UPL	UPL
Tidestromia oblongifolia (S. Wats.) Standl 2,3		UPL	UPL	UPL	UPL	UPL
Wyethia mollis Gray 2, 7		UPL	UPL	UPL	UPL	UPL

1 Barbour and Billings (1988)
2 Barbour and Major (1977)
3 Hunt (1966)
4 Hunt (1975)
5 Scott et al. (2000)
6 Stone (1956)
7 Thorne (1976)
8 Vasek (1983)
9 Wallace et al. (1980)
10 Went and Westergaard (1949)
11 West (1983)
12 Wondzell et al. (1990)

Phreatophytes with salt tolerance

Phreatophytes with salt tolerance are the dominant plants along playa margins and the extreme low slopes of alluvial fans. In these areas, the saturated zone, or the capillary fringe, is usually within 6 m of the land surface. It is here that the roots of the plant are anchored in order to access the water table (Lines 1979). Soils are sandy and silty and contain a high percentage of salts, which occur as hard layers on or just below the surface. Habitat conditions where these species grow allow them to have a dependable water supply, be independent of rains, and be able to respond to seasonal temperatures. The species reach their tolerance limit as the salinity of the groundwater increases farther into the playa, causing a precipitous decrease in numbers. The most abundant, salt-tolerant plants found in this high tolerance zone are *Allenrolfea* and *Salicornia* (Hunt 1965). To flourish in these high salinities, species have to exclude the uptake of salts or have the ability to anatomically isolate and/or excrete them (West 1983). Table 7 lists 17 phreatophytes with salt tolerance.

Table 7. Phreatophytes with salt tolerance.

1988 synonymy	Current name	Region 6	Region 7	Region 8	Region 9	Region 0
Allenrolfea occidentalis (S. Wats.) Kuntze 2,3		FACW	FACW	FACW	FACW+	FACW+
Atriplex canescens (Pursch) Nutt. 2,3		UPL	UPL	UPL	UPL	FACU
Baccharis sergiloides Gray 3		NO	FAC-	FACU	NO	FAC
Distichlis spicata (L.) Greene 2		FACW+	FACW	FAC+*	FACW	FACW
Juncus cooperi Engelm. 2,3		NO	FACW	FACW+	NO	FACW
Phragmites communis Trin. 3	*Phragmites australis* (Cav.) Trin. ex Steud.	FACW	FACW+	FACW+	FACW+	FACW
Pluchea sericea (Nutt.) Coville 2,3		NI	FACW-	FACW	NO	FACW
Prosopis juliflora (Sw.) DC. 2,3		FACU-	FACU	NI	NO	FACU
Prosopis pubescens Benth 3		FAC+	FACW-	FAC	NO	FAC
Sarcobatus vermiculatus (Hook.) Torr. 2		FACU+	FACU+	FACU*	FACU+	FACU
Scirpus olneyi Gray 3	*Schoenoplectus americanus* (Pers.) Volk. ex Schinz & R. Keller	OBL	OBL	OBL	OBL	OBL
Sporobolus airoides (Torr.) Torr. 2,3		FAC	FAC	FAC	FAC-	FAC+
Suaeda fruticosa auct. Non Forssk. 2	*Suaeda moquinii* (Torr.) Greene	NO	FACW	FACW	FACW	NO
Suaeda suffrutescens S. Wats. 3		UPL	UPL	UPL	UPL	UPL
Tamarix aphylla (L.) Karst. 2,3		FACW	FAC	FACW	NO	FACW
Tamarix gallica L. 2,3		FACW-	NO	NO	NO	FACW

1 Barbour and Billings (1988)
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11 West (1983)
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Application of the Lists

Compiling species lists from literature and field studies has traditionally been a mainstay of botanists for characterizing habitats. When knowledge of these specific adaptations and habitats are considered and organized into species lists, they can serve an important role in supporting the designation of wetland plant indicator statuses. In the past, wetland indicator statuses have been assigned within regions based on presumed frequencies of occurrence in wetlands, but as discussed here in the context of habitat specific lists, they can also be used to evaluate and compare their occurrences in various wetland habitat types. Examples of the benefits of this approach can be seen in species that are found at the edges of playas. Of the two types of playas—hard and soft—25 of the 48 species reported from the playa edge list (Table 2) are generally associated with hard playas. Interestingly, the 25 species associated with hard playas had mostly UPL indicator status ratings, while those of soft playas had OBL and FACW ratings (Table 2). Soft playas typically have the three characteristics necessary to delineate a wetland: hydrophytic vegetation, hydric soils, and hydrologic indicators (Lichvar et al. 2006). In contrast, hard playas lack groundwater and vegetation and usually have only hydrologic indicators; therefore, they are considered WoUS and are delineated using Ordinary High Water Marks methods. This distinction between the different playa types helps put the differences in habitats in context and allows a refinement in the wetland plant indicator status by distinguishing wetlands from WoUS.

Besides these two types of playa species, there are opportunistic species that are occasionally found at the edge of playas that may also inhabit many other types of habitats. Many of these species in Table 2 have variable indicator statuses ratings that make them problematic for delineations. For example, *Monolepis nuttalliana* (J.A. Schultes) Greene is one of these opportunistic species that frequently occurs around playas and has a wetland plant indicator status ranging from FACW to FACU within the region. This species occurs around both soft and hard playas, and when occurring on a hard playa, its occurrence is more associated with salt content in the soil rather than soil moisture. Species with distribution patterns similar to this could be given different ratings for various playa types or assigned a rating that has a broader frequency of occurrence for wetlands. But without focusing on occurrence in different playa types, the reliability of the rating is lowered. By being able to put species in context with specific habitats, wetland plant indicator panels will be able to better judge the ratings they are assigning within the habitat context for species in these problematic groups.

Another supportive role of these specialized habitat lists is the ability to identify those species that occur in other habitats and assess their frequency based on their overall habitat preferences. For instance, *Suaeda moquinii* (Torr.) Greene, a halophytic species, occurred in each of the six specialized groups. Since each of these habitats represents different hydrology and soil conditions, it is interesting to observe that this species has a FACW rating for its occurrences in a dry wash, where hydric soils almost never occur. The hydrology in dry washes is usually flashy; typically these habitats do not pond or stay saturated for more than 14 days and therefore lack the site conditions necessary to meet the hydrologic criteria of a wetland (Environmental Laboratory 1987). However, the site may be considered a WoUS based on other hydrology features used to delineate WoUS. In this ecological position, *S. moquinii* may be best considered a FAC or even a FACU species, depending on further observations and considerations. In contrast, this species is frequently encountered along the edges of soft playas where wetland features do occur and should be considered a FACW hydrophyte when placed in that context. With lists of species for specialized habitats ranging from playas to dry washes, indicator statuses can be compared across different habitats to ensure the usefulness and reliability of their ratings.

Riparian corridors, unlike some of the other specialized habitats, offer many inclusions of different types of habitats; therefore, it isn't surprising that the number of species in the dry wash is large (346) compared to the other specialized habitats. Some of the species in this list are associated with groundwater discharge and tend to have OBL or FACW ratings, while others include many of the phreatophytic shrubs that tap deeper groundwater resources. There are many upland species that get washed into channels during storm events and survive by responding to disturbances and conditions, such as soil texture, that mimic other habitat conditions where they typically reside and germinate. Thus, dry washes can provide a variety of micro-habitats all within one general habitat type.

The differences in geographic distribution patterns are more obvious when all these species from specialized habitats are compared by habitat occurrences across the Arid West region. Many species are reported from one or a few of the FWS regions, while others occur in all FWS regions. These variations in occurrences represent species distribution patterns associated with different floristic provinces. These differences point out that the flora of the Arid West region is not contiguous and identical across the entire region. The scale of the new ecoregion includes several floristic elements within the provinces. To assist with the floristic differences within the Arid West region, the new digital distribution maps complied by the Biota of North America Program (BONAP 2006) for the region can help clarify a species' geographic patterns.

5 Conclusions

Lists of species that occupy specialized habitats and are characterized by morphological and physiological adaptations can be used to better understand species ecology and occurrences across a region. This approach for considering all of a species' habitat preferences, range distributions, and special adaptations is valuable for assigning and increasing the reliability of wetland indicator statuses. Once wetland plant indicator statuses are assigned to a species, it is possible to double check the ratings by habitats to see if they fit the species occurrences across multiple habitats. It may not be possible to accomplish this for the entire wetland plant list for a region, but certain plant species and similarly acting species are recognized to have problematic wetland indicator statuses. For some of these species and groups, dividing species by habitats will allow for a better insight into wetland occurrence and will produce a more accurate hydrophytic vegetation determination.

Another method to develop more reliable wetland species lists is the use of subregions within a region. This has been done previously in the Northeast and Southeast regions, two former FWS regions, to accurately reflect the intraregional ecological variability of plant species (Reed 1997, Tiner 2006). The species occurrences shown in our tables imply that there are differences between different floristic provinces based on the presence or absence of species across the region. To adequately assign reliable indicator statuses to many species, it may be necessary, and helpful, for the Arid West region to be subdivided into smaller units, and then statuses can be assigned as needed on an individual basis by subregion.

The quality of the assigned wetland plant indicator statuses for any region relies on knowledge of a species' occurrence in wetlands, its occurrence in other types of habitats, and its biological responses to various habitat settings across its range. By having a more detailed perspective on a species' biological and distribution patterns, wetland plant ratings become more informative than just a frequency rating used in hydrophytic vegetation determinations. When evaluated within the context of how these ratings are used, the wetland plant list turns into a higher quality tool to be used by all wetland delineators and others who utilize the wetland plant list.

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14. ABSTRACT

The U.S. Army Corps of Engineers is currently regionalizing and updating the national wetland delineation manual. This manual will use new ecosystem boundaries for the nation. A separate effort by the Corps will update the National Wetland Plant List within these same new ecosystem boundaries. The Arid West is an area of particular interest in the revision of the plant list because of the problematic indicator statuses for certain groups of plants. Many species in the Arid West have morphological and physiological adaptations that allow them to occur in specialized habitats, ranging from wetlands to uplands. In delineations, the indicator status of these species is not always accurate for the specific location. A combination of literature reviews and recorded species data from previous studies for six specialty habitats are presented and discussed; the species groups are playa edge species, dry wash species, dry wash phreatophytes, hygro-halophytes, xero-halophytes, and phreatophytes with salt tolerance. A total of 421 species, with 93 of those species shared in more than one habitat type, are reported, including 48 playa species, 346 dry wash species, 62 dry wash phreatophytes, 32 hygro-halophytes, 47 xero-halophytes, and 17 phreatophytes with salt tolerance. The list for each specialized habitat will be used to better understand species ecology and occurrences across the region and will ultimately help in assigning and increasing the reliability of wetland plant indicator statuses.

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