Flora of the Upper Verde River, Arizona

by

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved June 2015 by the
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ARIZONA STATE UNIVERSITY

August 2015

ABSTRACT

The Upper Verde River of central Arizona flows through a landscape of complex geology at the meeting of seven biotic communities and three physiographic provinces. This has resulted in notably diverse flora and fauna and a hub of rare and endemic plant species. The river has sustained cultures since pre-history, however current regional water use is predicted to diminish streamflow over the next century. Prior to this project, no floristic inventory had been conducted along any section of the Verde. The purpose of this study was to develop a Flora of the Upper Verde River, with the goals of documenting rare and endemic species, the composition and abundance of wetland plants, and the factors shaping plant diversity in the region.

I made a total of 1856 collections and reviewed past collections to produce a checklist of 729 vascular plant taxa in 403 genera and 98 families. The most species-rich family is the Poaceae, followed by Asteraceae and Fabaceae. The flora includes 159 wetland taxa, 47 endemics, and 26 taxa of conservation concern, eight of which are Federally listed. Several new populations were found in these categories and of rarely-collected taxa including one state record, three county records and several range extensions. I report on the local status of several endemics, wetland taxa with limited distributions, and relict populations of a tepary bean (*Phaseolus acutifolius*) that were likely transported to the region and cultivated by pre-Columbian cultures. I categorize thirteen distinct plant communities, the most abundant being Pinyon/Juniper Woodland, Chihuahuan/Apacherian Scrub, and Riparian Deciduous Forest.

Four primary factors influence floristic diversity of the Upper Verde region: 1) a location at the junction of three physiographic and floristic provinces—represented by

co-occurrence of species with affinities to the Sonoran, Intermountain and Madrean regions, 2) geologic diversity—as distinct groups of species are associated with particular geologic types, 3) topographic and habitat complexity—allowing species adapted to disparate environments to co-occur, and 4) human introductions—since over 15% of the flora is composed of introduced species from Eurasia and several taxa were introduced to the region and cultivated by pre-Columbian cultures.

This thesis is dedicated to Gina, for her patience, love, unending encouragement and support; and to my family, for letting me loose in the outdoors as a child, for inspiration, and belief in their wandering kid.

ACKNOWLEDGMENTS

This thesis would not have been possible without the inspiration, guidance and help of several colleagues, family members, friends and mentors. The Upper Verde is an awe-inspiring, special place that holds personal significance for me. I'm honored to tell the story of its unique plant life.

I would especially like to thank my graduate committee for their mentorship, professional training, and extensive amount of time reviewing and improving this thesis. Each one of them has left their distinct imprint in these pages. I was privileged to have Dr. Juliet Stromberg as an advisor. Dr. Stromberg guided with creativity and scientific rigor that refined my perspectives and the ecological foci in this thesis. Dr. Leslie Landrum offered consistent and timeless advice to temper my many directions with careful consideration, simplicity and accuracy. Elizabeth Makings was a special mentor every step of the way, offering countless pieces of advice, thought-provoking conversations, and guidance during my countless hours in the ASU Herbarium. Sincere thanks goes to Dr. Walter Fertig for his appreciation of classic rock and encouragement to "turn it up", and for his always open door and enthusiasm as a mentor. Walt provided close guidance, advice and suggestions on many aspects of this thesis and has heavily influenced my perspectives on plant conservation and floristics.

A huge amount of appreciation goes to all of the students who have worked in the ASU Herbarium and contributed so much to this project. Not only for putting up with my excessive specimen material and world-record-worthy long labels, but for friendship and all the exciting exotic fruits. Many added their particular artistic touch to specimens which will be used for science and conservation long after we have left. Specific

appreciation goes to Linh Ngo, Lucie Indruchova, Aaron Boydston, Jean-Phillippe Solves, Anni Poetzl, Barbara Hackbarth, Lidia Peon and many others. I'm privileged to have been a part of the Stromberg Lab where each member contributed their perspective to this project. Lane Butler, Robert Madera Brenton Scott, Danika Setaro, Amanda Suchy, Dustin Wolkis and Tyna Yost, I will never forget the fun we had, whether in the field, herbarium or lab. I'll look forward to accordion, guitar and improvised hip hop when we meet again. Thanks also to those who helped on adventures searching for plants in the field. John Anderson, Ries Lindley, Elizabeth Makings, Brenton Scott, Sue Smith, Matthew Halldorson, Andrew Ulibarri, Michael Mansky, Christina Grijalva, and Elijah Allen. I was privileged to have my perspectives influenced on the biogeographical, geologic and ethnobotanical aspects of the Flora. Special thanks to John Anderson, Andrew Salywon and Wendy Hodgson for your conversations and inspiration.

Thanks to Drs. Martin Wojciechowski, Kathleen Pigg, Michael Angilletta, Christian Wright, and others for continually requesting me as a teaching assistant and employing me to design curricula. Graduate school would not have been possible without the always smiling help of Wendi Simonson, Yvonne Delgado and everyone else in the SOLS graduate office. Special thanks to the Tucson Chapter of the Arizona Native Plant Society and the Arizona State University School of Life Sciences for providing generous funding in the form of research and publication grants.

Lastly, I would like to thank my past mentors, without their inspiration and encouragement I would not be on this path. Drs. Kenneth Abbott, Tina Ayers, George Koch and John Spence, your perspectives and presence stay with me every step of the way.

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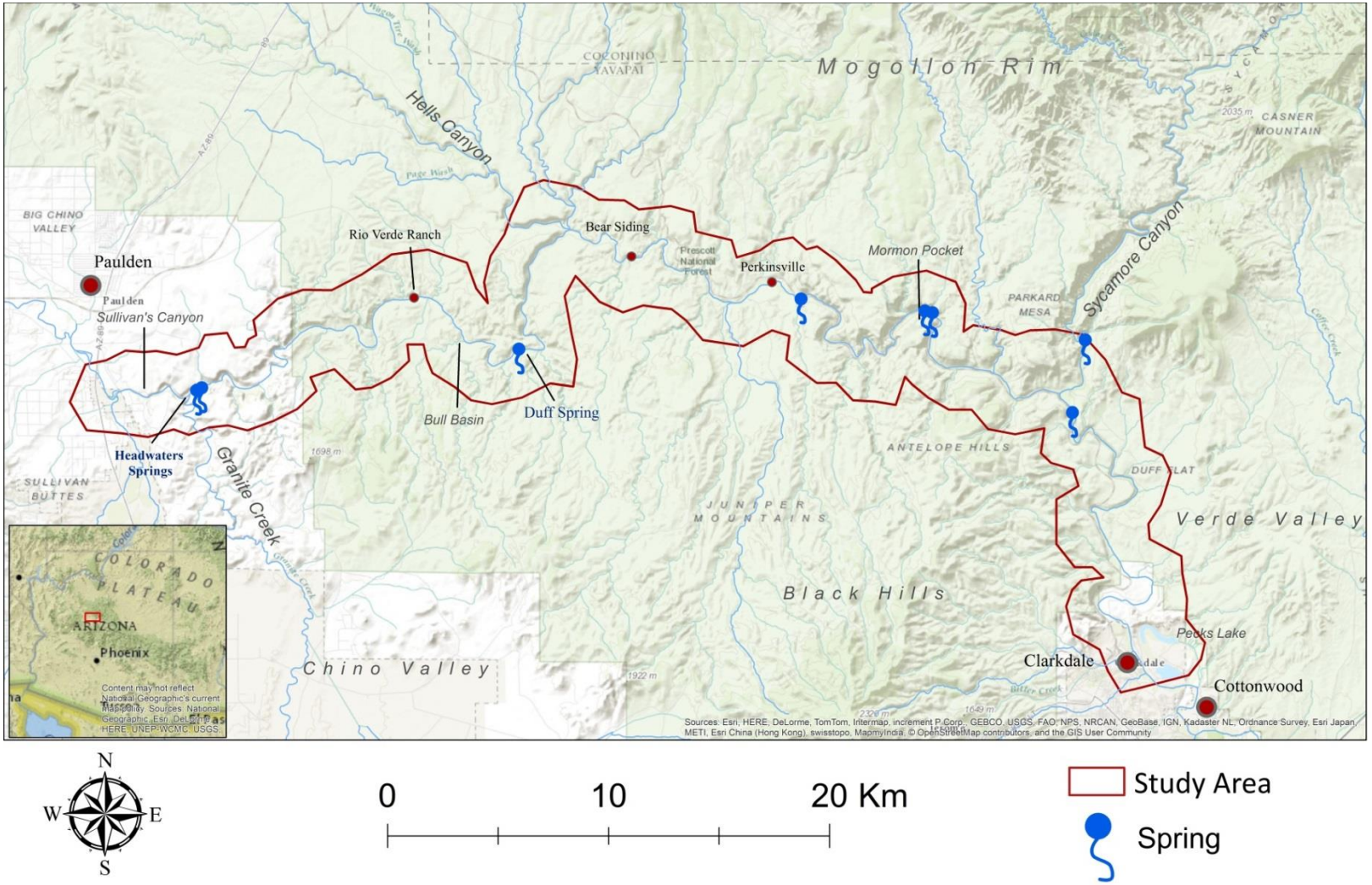

Figure 1. Map of the Upper Verde River and study area showing landmarks and place names mentioned in the text

CHAPTER 1

INTRODUCTION

Floras are essential to modern biodiversity sciences. In addition to documenting the distribution of species, diversity of regions and being central to taxonomy and systematics, they routinely answer questions in a wide variety of fields such as ecology, evolution and agriculture and inform land management and conservation (Funk 2006, Lavoie 2012, Rouhan and Gaudeul 2014). The earth's biota is in the midst of a human-induced sixth mass extinction event and future climate change is predicted to compound these effects (Ceballos et al. 2015). A key approach to protecting species and ecosystems and preserving the services they provide will be a thorough understanding of their diversity and distributions. Online aggregation and sharing of natural history collections data is seeking to accomplish this feat. Biodiversity informatics is rapidly advancing, allowing us to understand species distributions and floras with more power than ever before in history (Soberón and Peterson 2004, Bebber et al. 2010, Franklin 2010, Lavoie 2013). A limiting factor in these efforts, however, is the number and geographic extent of collections, since many regions and taxa remain undersampled (Graham et al. 2004, Paton 2009). While the demand for collections data is rising, and the supply more critical than ever, the rate of collections and floristic efforts are in decline (Prather et al. 2004).

In the arid southwestern United States, riparian corridors in particular have been underrepresented in comprehensive floras despite their role in sustaining local and regional diversity (Naiman et al. 1993, Sabo et al. 2005) and their well-documented historic decline (Webb et al. 2007). Although multiple streams in Arizona have had sections inventoried, no complete flora exists for any river in the state. A few examples

of partial river floras include the Colorado in the Grand Canyon region (Theroux 1976, Phillips et al. 1987, Ayers et al. 1995), Hassayampa (Wolden 1993, Wolden et al. 1995), Little Colorado (Crawford 2015), Gila (Haase 1973, Mcgill 1979, Minckley and Clark 1981, Jenke 2011), San Pedro (Makings 2003), Salt (Jenke 2011), and Santa Cruz (Mauz 2002) rivers.

The Verde River of central Arizona (Figures 1, 2 and 3) is another main southwestern river lacking a floristic inventory. It drains a primary watershed of Arizona (Figure 2), is a major tributary in the lower Colorado River basin, and is one of the last rivers in the southwest undammed for a majority of its length. The river and riparian zone supports a diverse assemblage of aquatic and terrestrial insects and over 380 species of fish, herpetofauna, mammals and birds, including 16 of conservation concern and 6 threatened or endangered (Haney et al. 2008). It has been utilized by humans since ca. 14,000 B.P., and intensive habitation has occurred over the last 800 years, as evidenced by an abundance of ruins throughout the area (Fish 1974, Elias 1997). Today the river attracts thousands of visitors each year for recreation and provides a large portion of agricultural and municipal water to central Arizona (Haney et al. 2008, Limbrunner et al. 2011, ADWR 2014).

The upper section, the "Upper Verde River" or UVR, is a 72 km long stretch from the headwater springs to the Verde Valley in Yavapai County (Figures 1, 2 and 4). This remote section is home to the primary springs producing a majority of the river's base flow. The Upper Verde River Springs (Figure 3A) emerge abruptly, turning a dry wash into a flowing river which proceeds to run through alternating canyons and wide valleys forming a ribbon of green through the desert landscape (Figures 3B, 4).

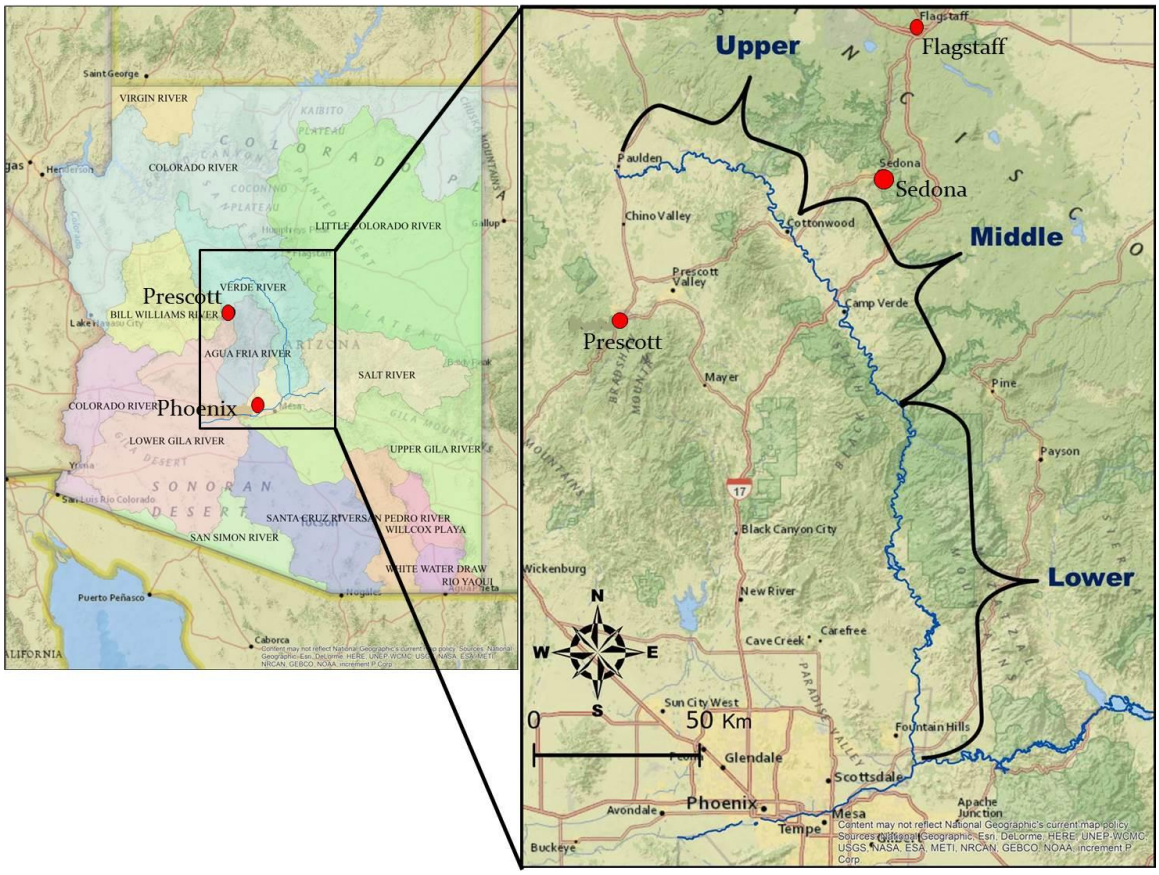

Figure 2. Main Arizona watersheds including the Verde River watershed (blue) and a blow-up of the Verde River showing the lower, middle and upper sections.

This rugged section lies at the junction of three physiographic provinces where an eventful geologic history has resulted in a topographically and geologically complex landscape (Figure 4). Here various biotic communities and biogeographic provinces meet, resulting in a unique flora home to multiple endemic and rare plant species (Baker and Wright 1993, Anderson 1996, Licher 2003) and a hub of Arizona endemics (Hodgson et al. 2013).

Upper Verde base flows are fed by springs from the Big and Little Chino Valley aquifers lying underneath the Chino and Williamson Valleys (Wirt and Hjalmarson 2000,

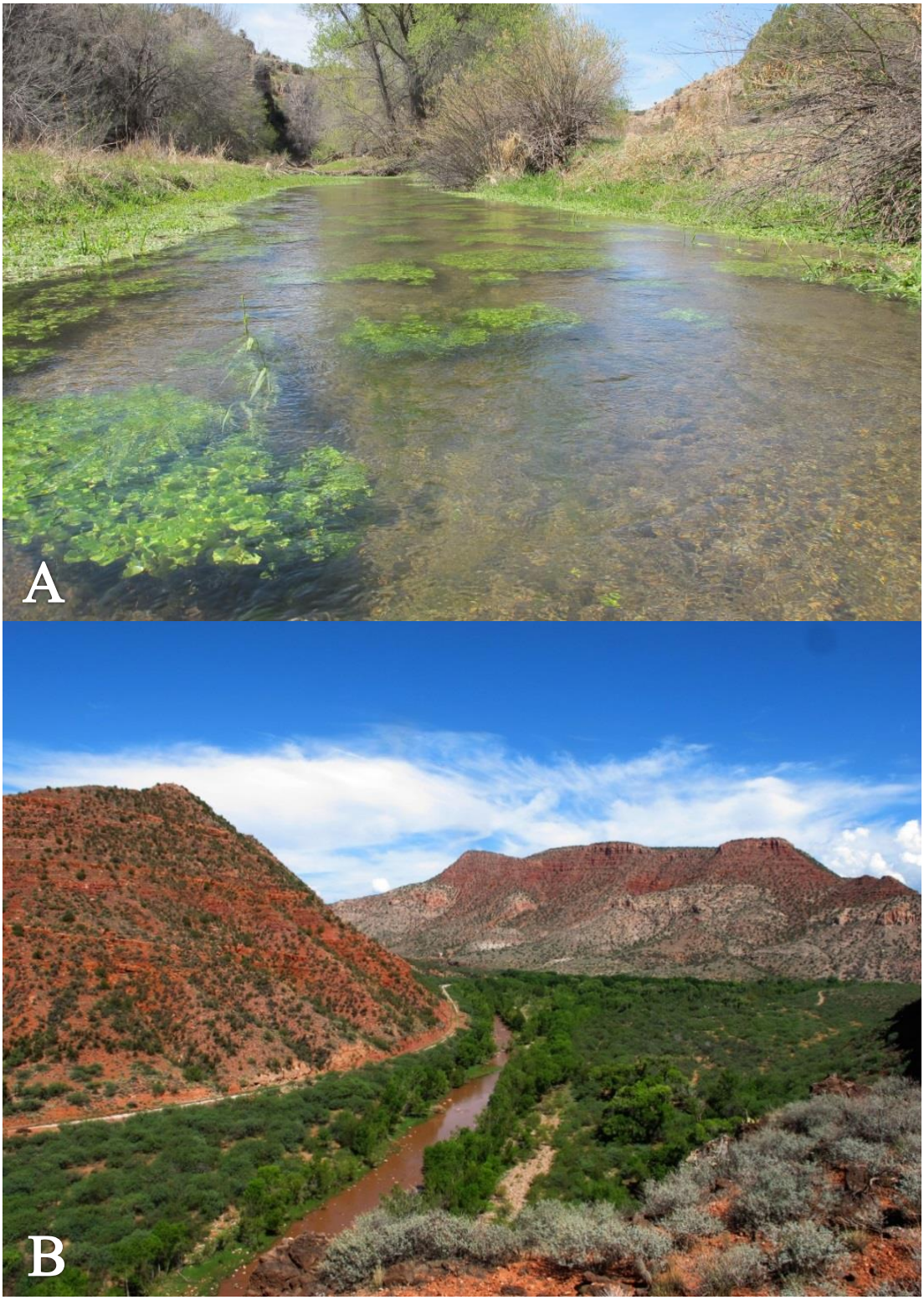

Figure 3. The Upper Verde River. A. Approximately 100 m downstream from the headwaters springs. B. Downstream at its confluence with Sycamore Canyon in the Verde Valley.

Wirt et al. 2005). Over a century of groundwater use and diversion has lowered water tables and depleted Verde stream flow (Wirt and Hjalmarson 2000). This trend is predicted to continue at current regional water use rates, with significant reduction in water tables and surface flow expected over the next century (Garner et al. 2013). This would lead to a loss of wetland and riparian plant species and their dependent fauna, resulting in ecosystem-level and regional consequences (Stromberg et al. 1996, Stromberg 2008, Haney et al 2008).

The importance of the Verde and its threats has drawn intense public attention and debate. Legal disputes have ereupted between stakeholders and local municipalities, there have been efforts to control extraction, conservation and research efforts by non-governmental organizations and state and federal agencies, protection of two stretches near the headwaters, and proposals to designate the entire Upper Verde as Wild and Scenic (USDA Forest Service 2010, www.vrbp.org). An understanding of the regional botanical composition and diversity is a key step towards predicting and mitigating future impacts to biotic communities from threats such as stream dewatering, detrimental land use, and climate change. This information tells us the number and identities of species affected by change, identifies those that perform ecosystem services such as bank stabilization and wildlife habitat provision, and the habitats, abundance and number of rare and endemic species.

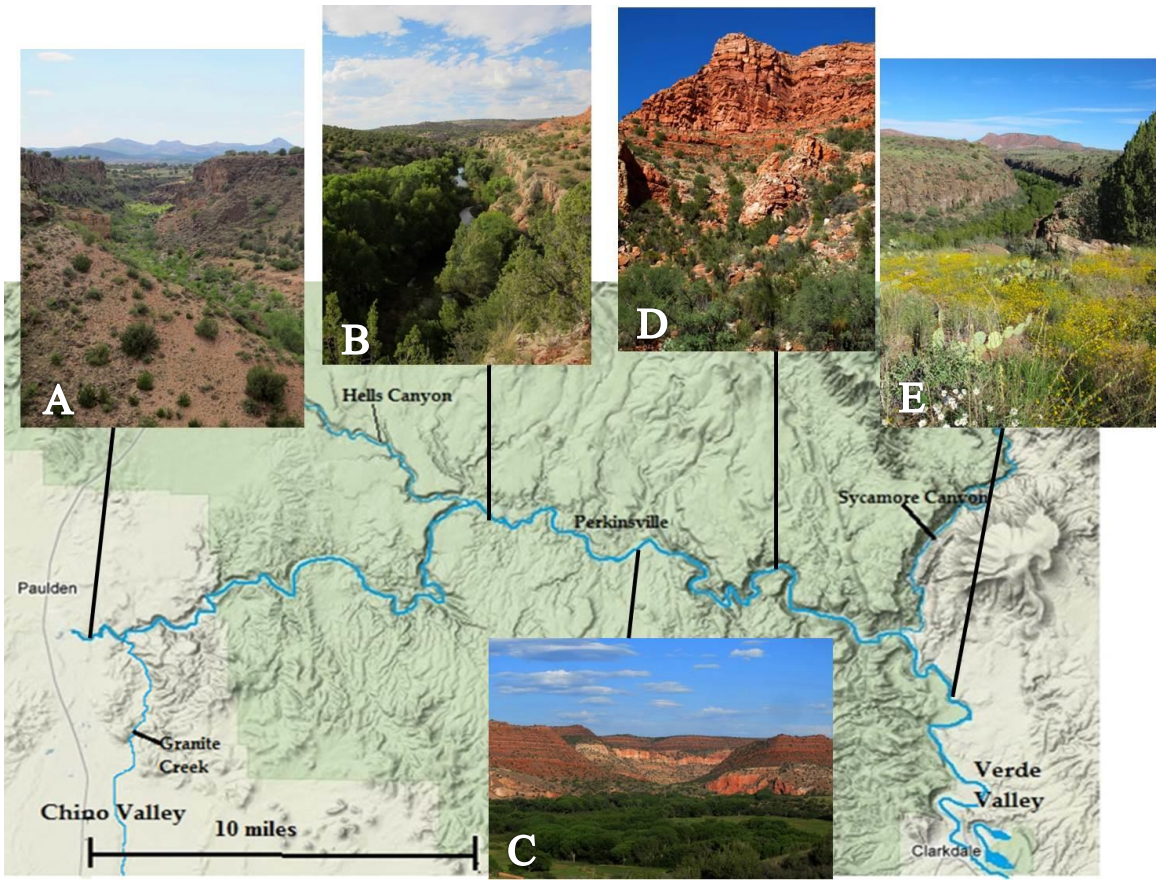

Figure 4. Longitudinal variation in geomorphology and geology along the Upper Verde River. A. Steep tertiary basalt-walled Sullivan's Canyon near the headwaters. B. Incised canyon in Paleozoic Redwall Limestone near Bear Siding. C. Broad alluvial valley and cliffs of the Supai Formation above Redwall Limestone at Perkinsville. D. Supai Formation cliffs near Mormon Pocket. E. The steep-walled Black Canyon made of columnar

The purpose of this project was a complete vascular plant inventory of the Upper Verde River riparian corridor and surrounding landscape from near its spring-fed sources downstream to the town of Clarkdale in the Verde Valley.

There were 4 main goals:

1) Collect and identify specimens of all vascular plant species encountered in the study area, review past collections, and compile information on each species (growth form, native status, wetland rating, and frequency) to produce an annotated checklist for the Upper Verde River. Share the checklist and specimen data through the online biodiversity portal SEINet (2015).
2) Report the composition and number of wetland taxa, taxa of conservation concern, and localized and regional endemics. Report the abundance and habitats of notable collections in these categories.
3) Categorize and describe general vegetation types in the study area.
4) Define the factors influencing floristic diversity in the Upper Verde region including its phytogeographic affinities to regional Floristic Provinces, association of species with geologic types, effects of habitat and topographic diversity, and introductions and cultivation by pre-Columbian and contemporary cultures.

CHAPTER 2

STUDY AREA

The Verde River

The Verde River (Yavapai: Haka'he:la) (Figures 2 and 3) is a perennial stream of Central Arizona and a significant drainage in the Lower Colorado River basin. Its perennial flows rise abruptly from a group of river-channel springs (Figures 1 and 3A) near Paulden, in the Chino Valley at 1295 m elevation, and run southeast for 306 km to their confluence with the Salt River, northeast of Phoenix at 404 m (Figure 2). It drains a watershed of 16,027 km^2, an area representing nearly 6% of Arizona that encompasses portions of the Colorado Plateau, Transition Zone and Basin and Range physiographic provinces (Figures 2 and 9). The elevation of the watershed extends from the top of San Francisco Peak, the highest point in Arizona at 3851 m down to the Verde River-Salt River confluence, in the Sonoran Desert, at 404 m (ADWR 2014, Wirt and Hjalmarson 2000).

The Verde is subdivided into three sections based on hydrological and geomorphological criteria and the watersheds they drain (Figure 2): 1) the Upper Verde River (UVR), flows from the headwaters near Sullivan's dam to the USGS gauge at Sycamore Canyon near Clarkdale, Arizona, 2) the Middle Verde River (MVR), flows from Sycamore Canyon to Camp Verde, Arizona and 3) the Lower Verde River (LVR) from Camp Verde to the confluence with the Salt River. Aside from the small Sullivan's Dam near the headwaters and a few minor irrigation diversions, the mainstem remains undammed for approximately 201 km until it reaches Horseshoe Reservoir approximately 45 km upstream from its confluence with the Salt River.

The Study Area: The Upper Verde River

The study area (Figure 1) includes the entire Upper Verde River from Sullivan's Lake, south of Paulden, at an elevation of 1341 m, downstream approximately 72 km to Tuzigoot Bridge near the town of Clarkdale at 944 m, an elevation change of approximately 396 m. The highest elevations occur at Packard Mesa, near the Verde Valley, at 1494 m. The study area included tributaries and their canyons or valleys, rims, mesas and hills within a distance of approximately 1.5 km on both sides of the river, forming an area of 193 km^2 (19,300 hectares, 47,691 acres, 75 mi^2).

Land Ownership

The Upper Verde lies completely within Yavapai County, Arizona. A majority of the study area is USDA National Forest Service land within the Prescott National Forest (Figure 5) with a 15 km long section in the Verde Valley within the Coconino National Forest. The remainder is owned by private land owners (Perkinsville Ranch, Rio Verde Ranch, Clarkdale Mining Company, Phelps Dodge, and small units near Clarkdale and Sycamore Canyon), the Nature Conservancy (796 acre preservation parcel near the headwaters), Arizona Game and Fish Department (8 km conservation area near the headwaters), and the Arizona State Land Department (mesas near the headwaters on Arizona State Trust lands). There are three private conservation easements near the headwaters owned by local individuals (Yavapai County 2015).

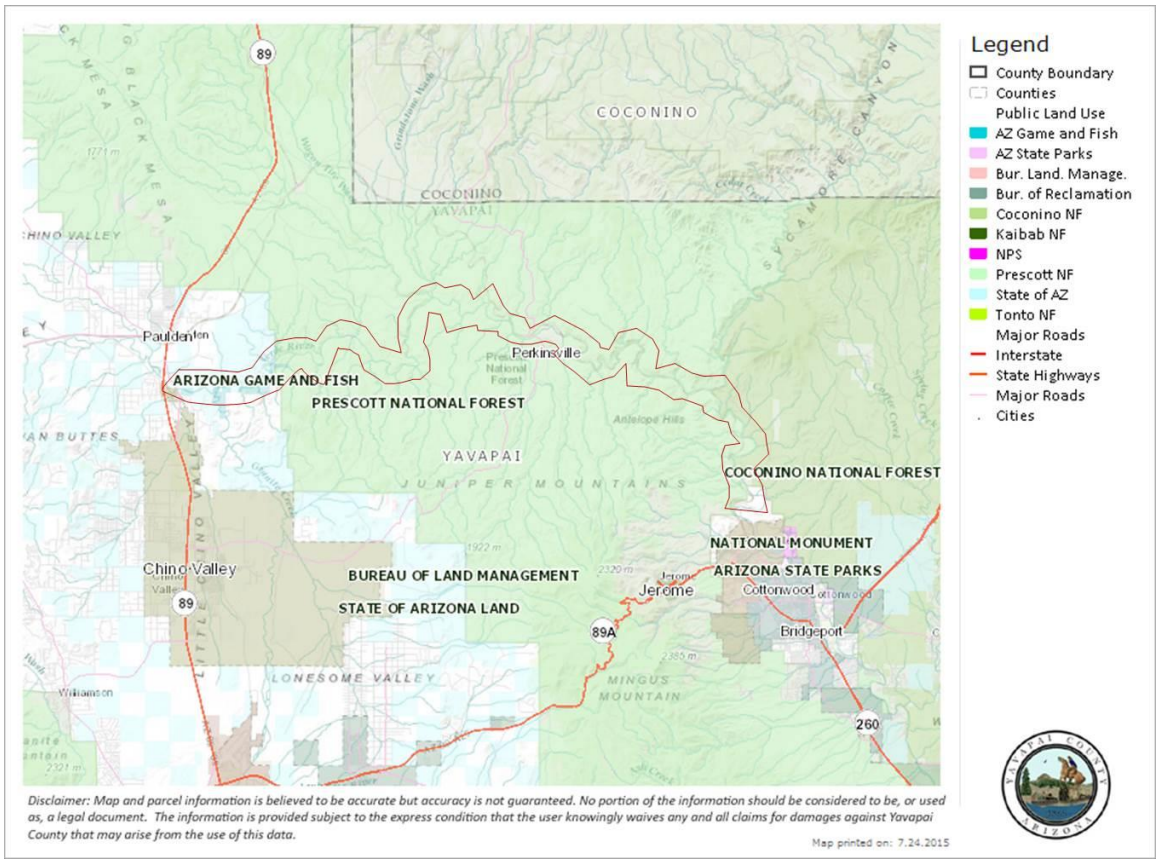

Figure 5. Land ownership map for the Upper Verde River showing surrounding municipalities, important landmarks, and the study area boundaries in red (Courtesy of Yavapai County Government http://www.yavapai.us).

Climate

The Upper Verde River region has a semi-arid climate with relatively low annual rainfall, high summer temperatures and winter nights frequently falling below freezing, especially in the higher elevations. Climate is similar to much of the Southwestern US with cycles of winter precipitation, spring drought, summer precipitation and fall drought (Ffolliott and Davis 2008). The area has an annual bimodal precipitation regime with more than half of moisture falling during winter storms (December-February) and a little less than half during late summer monsoons (July-September). April, May and June are the driest months of the year. Winter moisture is dominated by gentle, widespread frontal

rain and snow storms that move in from the Pacific Ocean. Late summer rains are arrive as monsoons in the form of intense, brief, localized convection thunderstorms from the Gulfs of California and Mexico (NOAA 2004).

Figures 6 summarizes precipitation and temperature averages and extremes in the Chino Valley and at Tuzigoot National Monument near Clarkdale over 72 and 36 year periods respectively. Average temperatures peak in July at 38 ^{o}C and 33 ^{o}C at the lower and upper elevations respectively. Upper elevations have average lows below freezing for three months per year while lower elevations experience less than one month per year. Both average annual temperature and precipitation are higher at Tuzigoot (Western Regional Climate Center 2013).

Annual precipitation has averaged 29 cm in Chino Valley to 32 cm at Tuzigoot National Monument (Western Regional Climate Center 2013). Snowfall is more common in the upper elevations where average monthly winter snowfall ranges from 25-50 mm and single storms can produce up to 30 cm. In the lower elevations such as the Verde Valley, snowfall is less frequent with winter months averaging less than 25 mm and larger storms producing 76 mm (Western Regional Climate Center 2013). Winter storms can produce steady, heavy rainfall for multiple days, causing large scale flooding of the Verde River and its tributaries.

Figure 7 shows total monthly precipitation during the three year study period compared to long term averages for Chino Valley and Tuzigoot National Monument. During all three years of the study, winter and spring precipitation were below average while monsoon precipitation was above average, especially in 2012 and 2013. Sections of

the study reach had up to 300% of the normal during 2012 monsoons and 800% during 2013 monsoons (AHPS 2013).

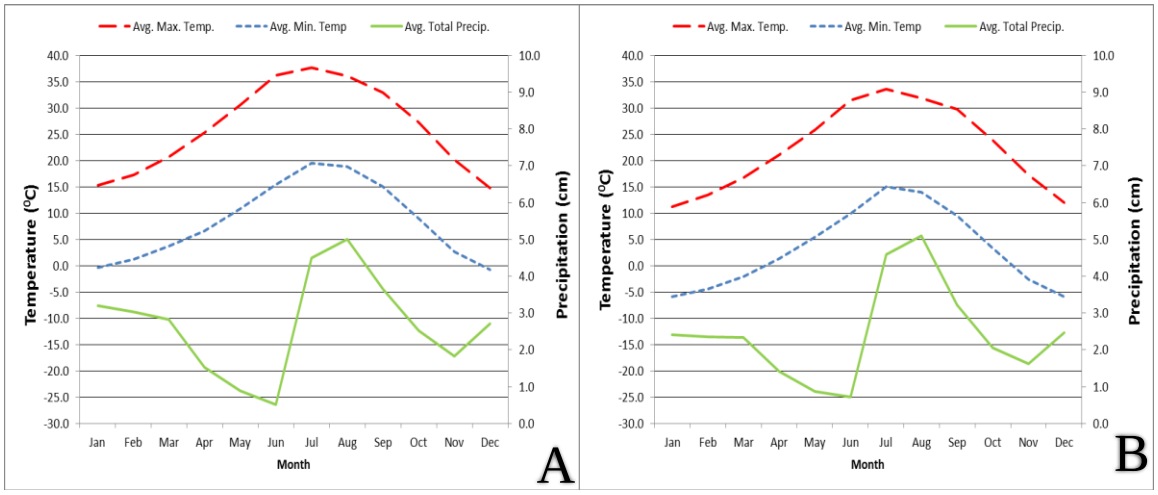

Figure 6. Average monthly minimum and maximum temperatures and average monthly total precipitation during a 36-year period at Tuzigoot National Monument (A) and a 72-year period for Chino Valley (B) (Western Regional Climate Center 2013).

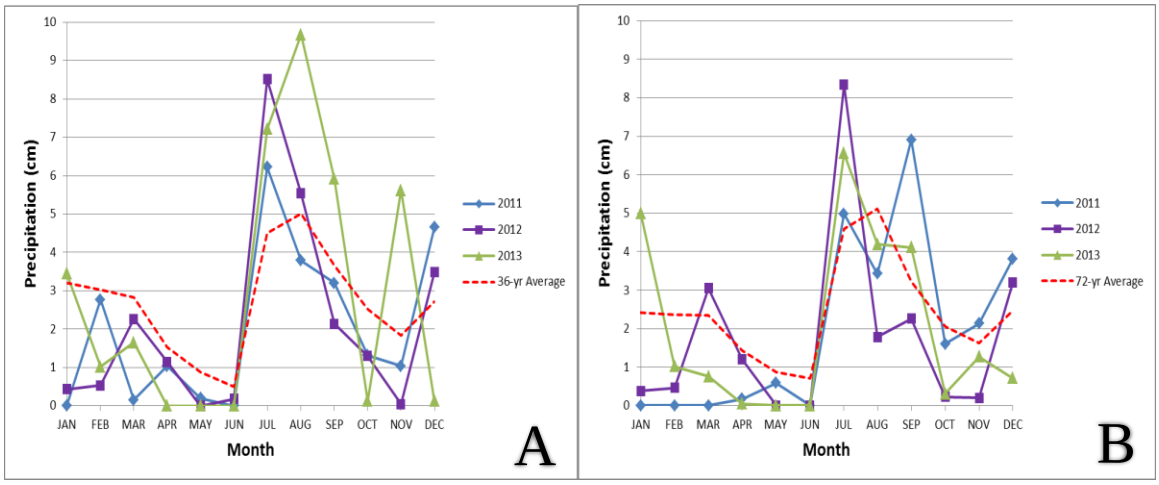

Figure 7. Three-year monthly precipitation totals during the study period and long term averages for Tuzigoot National Monument (A) and Chino Valley (B) (Western Regional Climate Center 2013).

Hydrology

The Verde River has a large headwaters region of intermittent and ephemeral streams (Figure 8). Main drainages enter through broad alluvial valleys and include the mostly-dry Big Chino wash from the Seligman area, Santa Maria and Juniper Mountains of the west, and the intermittent Granite Creek from the Bradshaw Mountains/Prescott area to the south.

At the upstream boundary of the study area the Big Chino Wash enters Sullivan's Lake, a small reservoir now completely filled with sediment formed when a dam approximately 15 m in height was built in 1936. Below Sullivan's Lake, the wash enters the steep, basalt-walled Sullivan's Canyon (Figure 4), considered the beginning of the Verde River proper, where streamflow is ephemeral and surface water consists of pools between large boulders.

Prior to the early 1970's, perennial flows began 8 km upstream at Del Rio Springs and flowed through Sullivan's Canyon but discharge decline left this section dry (Wirt and Hjalmarson 2000). The first perennial trickle currently emerges downstream from Sullivan's Canyon and runs into the 1 km long Stillman Lake. Just downstream where Granite Creek enters, the majority of perennial flows arise from a series of river-channel springs known as the Upper Verde River Springs, Big Chino Springs, or Headwater Springs (Figures 1, 3 and 8). These springs are primarily derived from the Big Chino basin-fill aquifer (80%) and Little Chino basin-fill aquifer (14%) (Figure 8) (Wirt et al. 2005). Additional groundwater contributions occur near Perkinsville and Mormon pocket from unconsolidated aquifers on the Colorado Plateau (Wirt et al. 2005, Wirt and Hjalmarson 2000). Other, smaller springs are interspersed along the study area. Some of

these arise from hillslopes and tributary washes, and others from the river bottom (Figure 1).

Upper Verde River base flow has remained relatively constant at the upstream end, near the headwaters over a 50 year period ranging from 22 to 26cfs with an average of 25cfs. Low variation in the upstream end is due to constant supply from the aquifer-fed Upper Verde River springs (Wirt et al. 2005). At the lower end of the study area, a portion of flows are fed by springs dependent on inter-annual precipitation and and base flows reflect this, fluctuating between 80 and 200 cfs with an average of 165cfs (Figure 9) (Wirt and Hjalmarson 2000).

While base flow has remained relatively consistent from year to year, intra-annual flows fluctuate dramatically (Figure 9). Precipitation events in the winter and during summer monsoons result in both acute and sustained flood events, some of them large scale, turning the peaceful Verde into a torrential mud slurry. During the 1993 El Nino event (ENSO), the Verde rose far above its banks into extensive floodplains in the Verde Valley, destroying property, including entire homes, and forcing 250 evacuations (Engler 2008, personal obs.). This event and others before it are associated with removal of large tracts of riparian forest and changes in channel structure and course (Neary et al. 2012).

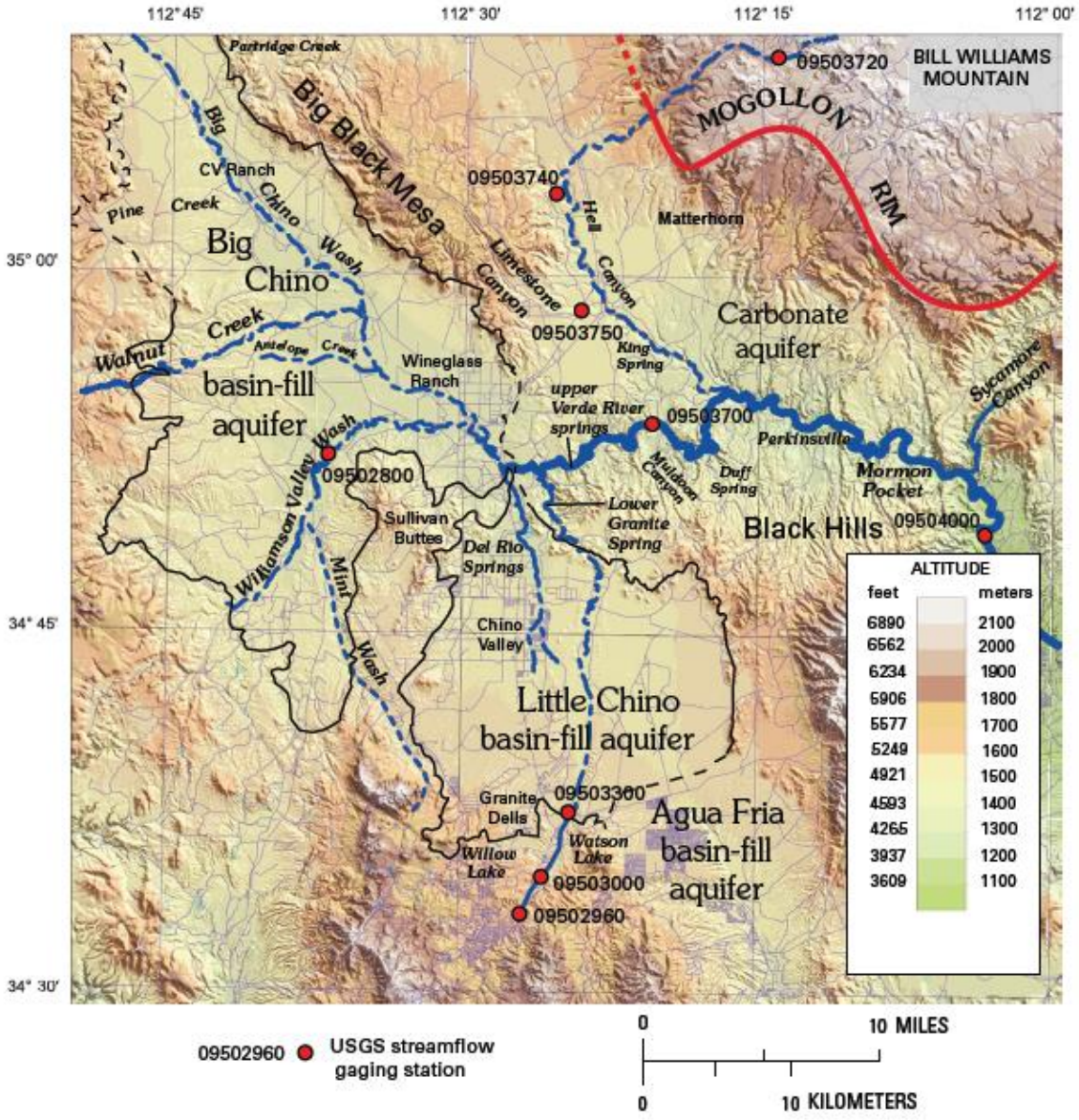

Figure 8. Shaded relief map showing the Upper Verde River and surrounding major physiographic and hydrologic features (from Wirt et al. 2005).

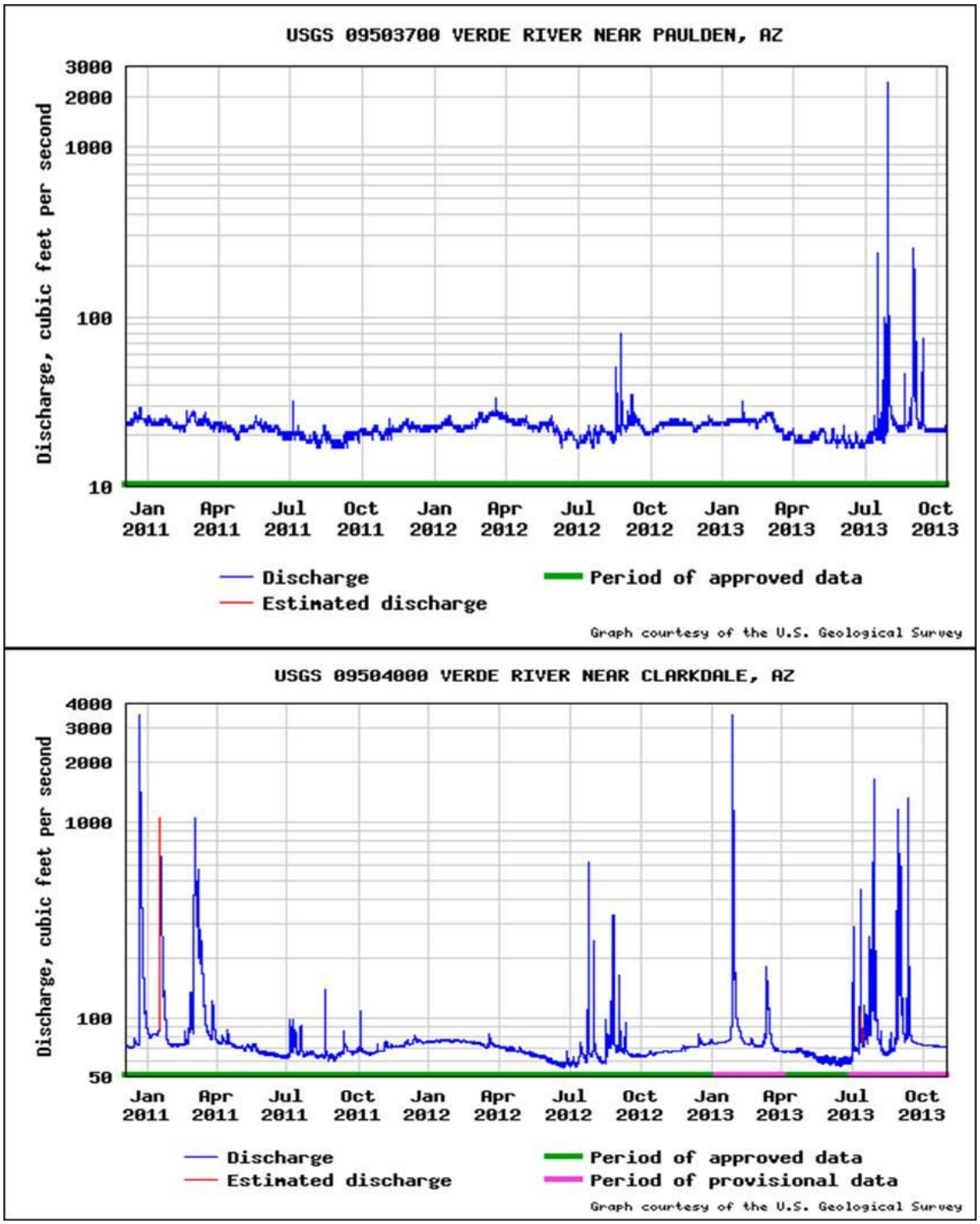

Figure 9. Daily discharge at the Paulden (top) and Clarkdale (bottom) gauges during the study period (2011-2013) (http://waterdata.usgs.gov/az/nwis/rt).

Physiography and Geology

Physiographic Description

The Upper Verde River flows through the Central Highlands, also called the Transition Zone physiographic province which lies between the Colorado Plateau to the north and the Basin and Range Province to the south. The Transition Zone has geologic and physiographic features of both the Colorado Plateau and the Basin and Range. provinces (Langenheim et al. 2006). It is characterized by series of high rising mountains separated by deeply-incised alluvial basins, and possesses highly rugged and abrupt topographic relief (Pearthree 1996).

The major landscape features defining the Upper Verde region (Figures 1 and 8) are the Mogollon Rim, a 300-600 m tall escarpment marking the southern edge of the Colorado Plateau and rising abruptly 16 km northeast; and the Black Hills (including Woodchute and Mingus Mountains), a northwest-southeast orientated range consisting of a 30 km long fault block rising gradually 13 km to the south (Lehner 1958, Abbott and Cook 2007). The Black Hills are typical of Transition Zone ranges which tend to run parallel to intermountain basins such as the Upper Verde River basin (Lehner 1962). The edge of the Colorado Plateau is at ca. 1950 m while the tallest peaks in the Black hills are at ca. 2400 m. Inbetween lies the Upper Verde River 1219 m below. The Upper Verde River valley forms a broad basin (ca. 30 km wide) between these two features with foothills descending to the river, along the way bisected by young, often parallel tributaries, some of these deeply incised canyons and others more broad alluvial washes.

Other main features that define the area include the Big and Little Chino Valleys, surrounding the headwaters, and the Verde Valley, surrounding the lower end of the study area. Both areas form large (ca. ,1036 km^2 and 1165 km^2 respectively), mostly alluvium-filled basins (Langenheim et al. 2006). These basins are two of a series of northwest-southeast orientated sedimentary basins that span the transition zone of central Arizona separating the Colorado Plateau from the Basin and Range province (Nations et al.1981). The river itself occurs for the most part in a deeply entrenched canyon well below the local topography (Pearthree 1996).

Physiographic and Geologic History

The Upper Verde River region possesses an eventful history of tectonic and volcanic events that have led to the complex topography and geology seen today. This history and extant edaphic mosaic is of chief influence on plant species composition and distribution in the region (Figures 10 and 11). The valleys along the Upper Verde River's current course likely existed as paleovalleys initiated by uplift and faulting during the Laramide Oregeny period of mountain building during the Cretaceous-Tertiary (80-30 mya) and subsequent valley erosion during the mid-Tertiary Miocene (30-23 mya) (Nations et al. 1981). The formation of these valleys and downcutting of the ancestral Verde River coincided with, and were likely driven by, the Late Cretacious- Mid-Tertiary(33-25 mya) uplift events of the Colorado Plateau and formation of the Mogollon Rim escarpment (Pierce et al. 1979). During this period, ancestral streams in the valleys flowed northwest, depositing ancient sediments that can be seen in patches today (Lehner 1958). After this period, the ancestral Verde River changed course to the southeast, the general direction of its current route (Lehner 1958, Nations et al. 1981).

The late Miocene-early Pliocene (15-10 mya) was marked by faulting and frequent volcanic activity. Early eruptions (ca. 15 mya) in the area deposited older basalts including those of the Hickey formation. Faults in the area such as various northwest-southeast faults and the Verde Fault (Figure 11) became active post 12 mya. Some led to further depression of the Verde River valleys and others participated in uplift of other landforms such as the Black Hills fault block (Lehner 1958). The Verde Fault also slowly separated the Colorado Plateau from the Black Hills (Lehner 1958, McKee and Anderson 1971). Extensive faulting in the area caused monoclines, abruptly rising mesas, provoked the erosion of canyons and valleys, and exposed various Paleozoic (ca. 500-300 mya) sedimentary formations that led to much of the topographic and geologic diversity that can be seen today (Lehner 1958, DeWitt et al. 2008).

Later (8-5 mya), volcanic flows poured over the Mogollon Rim into paleovalleys in the Verde Valley, Perkinsville, Hells Canyon and Chino Valley areas and basalts were deposited such as those of the Perkinsville formation and "Rim Basalts" (Anderson and Creasey 1958, McKee and Anderson 1971). Basalt flows and faulting created basalt dams and depressions (grabens) that blocked downstream movement of the ancestral Verde River both in the lower part of the Chino and Verde Valleys (Nations et al. 1981). This produced large, freshwater lakes and marshes that filled valleys and deposited calcium carbonate, forming lacustrine formations of the Verde Formation in the Verde Valley and smaller deposits in the Chino and nearby valleys (Nations et al. 1981, Pearthree 1996). Eventually the dams were breached and downcutting of the Verde River commenced (Pearthree 1996).

The entrenched nature and route of the Verde River as we see it today likely began around 10 mya (Pearthree 1996). More uplift in the region around 2.5 mya likely added to entrenchment and further cutting through Paleozoic formations. During the Quarternary (1.8 mya-present) the river has changed routes several times and at various locations and has had varying elevations, along the way depositing alluvial sediments and gravels that exist as river terraces today (Pearthree 1996).

Geologic Formations

The eventful geologic history of the Upper Verde region led to the complex landscape structure and mosaic of geologic formations going back 2000 million years (Figures 10, 11 and Table 1). The oldest rocks were formed during the Proterozoic (>1000 mya) and include two igneous/metamorphic rock types, the Verde Granitiodorite and a gabbro, that occur within one small section (ca. 5 square km) of the study reach near Duff Spring. The next most recent are early Paleozoic (300 mya) sedimentary rocks exposed during faulting and uplift of the Miocene and Pliocene (Lehner 1958) as discussed in the previous section. These include, in ascending order; Tapeats Sandstone, Martin Formation (Limestone and Dolostone), Redwall Limestone and the Supai Group (Sandstones, mudstones and limestone). Late Tertiary-Quarternary (30-2 mya) groups deposited during relatively recent activity discussed in the previous section include; the Hickey Group (Basalt), Perkinsville Formation (Sedimentary, Basalt) and the Lucustrine deposited Verde Formation (Sedimentary, Basalt) (Figures 10 and 11, Table 1). The most recent activity from the Quaternary (1.8 mya-Present) includes Pleistocene (1.8Ma-0.01 mya) and Holocene (0.01 mya-Present) colluvium and alluvium deposited both along the

river as terraces, from incoming washes and on hillsides and mesas along the river valleys.

The most abundant formations in the study area are the Martin Formation, made up of various marine limestones and dolostones; the Supai Group, composed of the red sandstones and marine limestones that make Sedona famous; and the marine Redwall Limestone. Other large areas in the Verde Valley are dominated by the lacustrine limestones of the Verde Formation. Thus, most of the area is dominated by limestone-derived calcareous soils. The next most abundant groups are the mesa-forming Miocene-Pliocene basalts associated with the Perkinsville and Verde Formations. Many other minor components are dispersed in smaller patches in between. Three of these minor formations are significant due to the presence of many plant species not found in other areas of the study reach. These are the Tapeats Sandstone and two intrusive igneous groups; Granodiorite of the Verde River and Gabbro. These are found only in the middle of the study area between Rio Verde Ranch and Duff Spring (Figure 11) (DeWitt et al. 2008).

Geomorphology

The mostly entrenched Upper Verde River winds its way through alternating narrow bedrock canyons and broader alluvial valleys (Figure 4). This section is characterized by a channel that is mostly constricted by canyon walls and slopes on either side. In narrow areas, sediment deposition is limited to channel deposits, narrow and interrupted terraces, and flood deposits where tributaries enter. In these areas floodplains, low terraces and secondary channels are often narrow or non-existent. In some sections, the river is bordered by abrupt cliffs or hillslopes on both sides.

Broader alluvial valleys occur in Perkinsville, in the central part of the study area, upstream from Clarkdale, and in smaller patches near Campbell's and Rio Verde Ranches. In these areas the canyon opens up, the river plain is broader with gentler slopes descending to the riverside. Often alluvial deposition has occurred and previous courses and levels of the river are preserved on high terraces. Floodplains, secondary channels and terraces are much broader and tributaries deposit sediment as alluvial fans on floodplains, often altering the course of the river (Pearthree 2008, Personal observations).

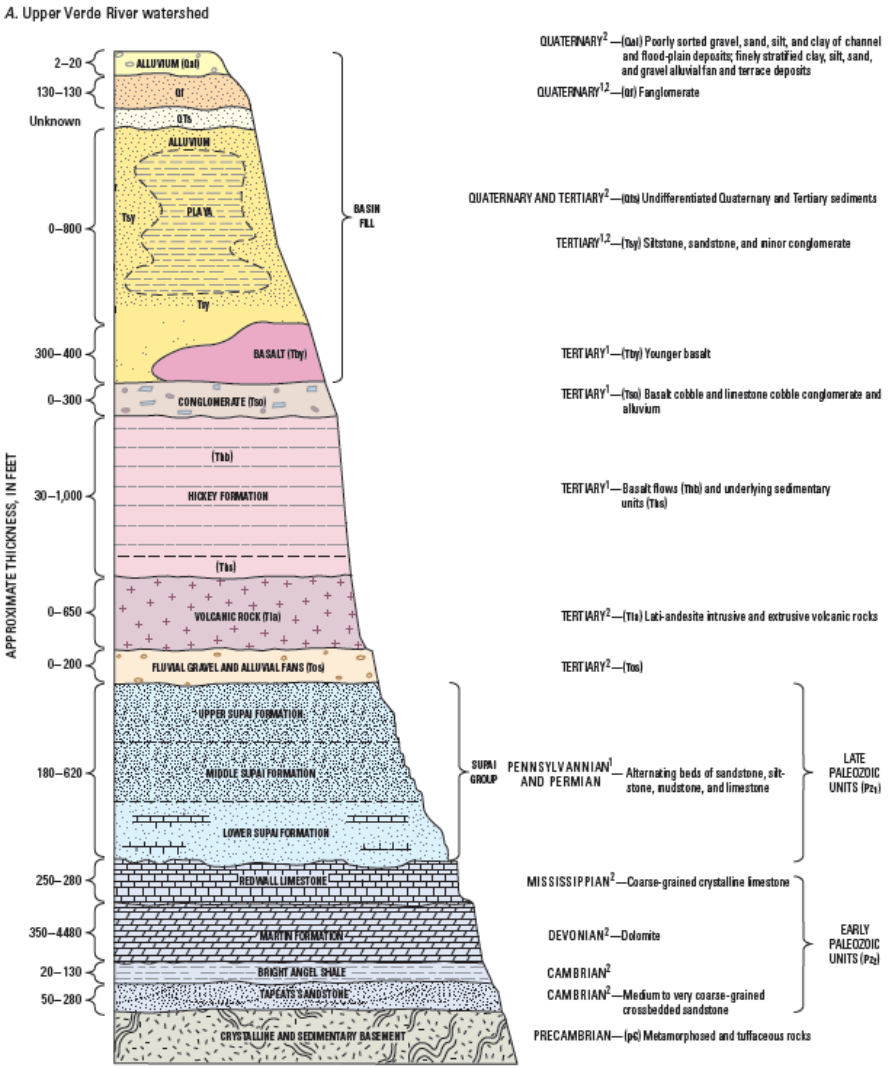

Figure 10. Generalized stratigraphic section for the Upper Verde River region (From Blasch et al. 2006).

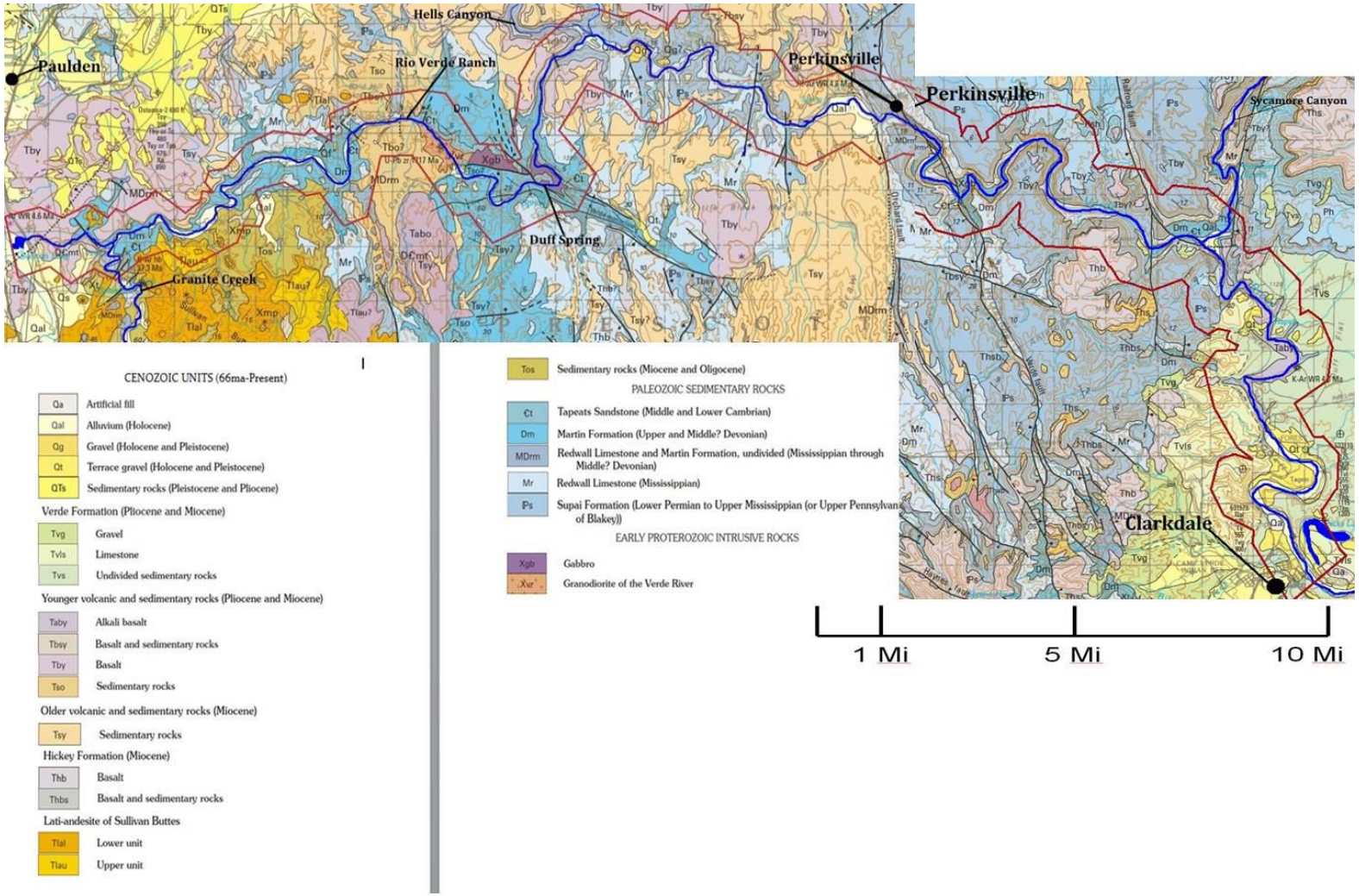

Figure 11. Geologic map and legend of geologic formations. Study area is outlined in red (DeWitt et al. 2008)

Geologic Era(In order of most recent to oldest)	Formation	Age(In order of most recent to oldest)	Map Symbol(s)	Description	Chemistry	Abundance/area(s) found
Cenozoic (66 Ma-Present)	Quarternary Deposits	Quarternary: Pleistocene and Holocene(1.8Ma-Present)	Qg, Qal, Qt, Qa, QTs	Recently deposited colluvium and alluvium in present day streambeds and on terraces; includes silts, sands (Qal) , sand and gravel(Qg), more pure terrace gravels(Qt), Sedimentary Rocks(QTs) and Artificial Fill (Qa) from manmade structures. In many areas forms alluvial fans, terraces and major floodplain and channel deposits.	Various; depends on parent material	Abundant along river and main tributaries.
	Verde Formation	Tertiary: Late Miocene-Pliocene (7-2Ma)	Tvg, Tvls, Tvs	Lacustrine(Freshwater) sedimentary deposits including silty limestone (Tvs) ,(Tvls); often containing pebbles and gravel(Tvg);Forms extensive sandy, gravelly and loamy flats and valleys, hillsides, buttes and layered rocky mesas and cliffs.	Mostly calcareous	Dominates mesas, flats and slopes in Verde Valley section of study area north of Clarkdale to Sycamore Canyon.
	Volcanic Flows and Sedimentary Rocks associated with Verde and Perkinsville Formations	Tertiary: Late Miocene-Pliocene (7-4Ma)	Taby, Tbsy, Tby, Tso,	Includes basalts of flows from Mogollon Rim and various vocanic fields into canyons and valleys. Alkalic basalt flows(Taby) in Verde Formation; non-alkalic basalts of Verde and Perkinsville formations(Tby); basalt with interbedded sedimentary conglomerate(Tbsy) and Sedimentary Rocks from ancient streambeds(Tso). Forms mesas and caps areas forming cliffs and steep talus slopes. Sedimentary areas forming deep, cobbly soils.	Varies: average, alkalic , K or Mg-rich	Abundant. Forms extensive basalt mesas and cliffs in study area. Perkinsville formation is abundant on mesas near headwaters in Chino Valley, at Hells Canyon confluence downstream to Perkinsville; alkalic basalt flows dominate Verde River Canyon and mesa from Sycamore Canyon downstream to Clarkdale.
	Hickey Formation	Tertiary: Miocene(10-15Ma)	Thb, Thbs	Basalts including flows and cinder cones(Thb) with minor interbedded sedimentary features(Thbs). Forms gently sloping mesas, caps and rims.	Average to Potassic, Mg rich and some Fe rich	Infrequent; a few isolated areas and mesas near Sycamore Canyon confluence and Mormon Pocket.
	Sullivan Butte Basalt(Andesite)	Tertiary: Oligocene-early Miocene (27-21Ma)	Tlal, Tlau, Tos	Basalts; includes flows, domes, cinder cones and intrusive centers(Tlal &Tlau), and some sedimentary(Tos)including local fluvial conglomerates, sandstones and fresh-water limestones. Forms basalt buttes, mesas and large bouldered talus slopes.	K and Mg rich	Infrequent. Hillsides and buttes above headwaters
Paleozoic(541-252Ma)	Supai Formation	Late Permian to early Mississippian(Avg: 280Ma)	Ps	Red siltstone, sandstone, silty dolomite, and minor conglomerate. Forms layered cliffs and rocky talus slopes.	Various, some layers calcareous	Abundant: Begins near Hells Canyon confluence downstream to Perkinsville on hillsides above river; dominates mesas downstream from Perkinsville through Mormon Pocket to Railroad Fault and Packard Mesa at beginning of Verde Valley.
	Redwall Limestone	Mississippian (359-320ma)	Mr	Gray to reddish-white limestone and minor chert. Forms narrow mesas, straight cliffs and caves.	Calcareous	Abundant. Beginning downstream from headwaters, dominates much of the Verde River canyon from Hells Canyon confluence downstream to Perkinsville. Then dominates lower section of canyon walls from Mormon Pocket to Sycamore Canyon confluence.
	Martin	Devonian(440-400Ma)	Dm	Dark-gray to whitish dolomite, limestone, and sandy siltstone. Forms narrow mesas and flats, layered cliffs and bouldery/gravelly slopes.	Ca and Mg-rich; calcareous	Highly abundant. May be the most abundant unit in study area. Forms steep cliffs along much of the Upper Verde River and side canyons.
	Tapeats Sandstone	Middle to late Cambrian, possibly with Devonian formations(ca. 700-400Ma)	Ct	Dark reddish-brown sandstone and conglomerate. Forms small mesas, layered cliffs and course-sand flats.	Various with high proportions of metals(Fe, Cu etc…); most not calcareous	Rare. Near Verde Ranch along river to Duff Spring(ca. 3 sq.mi), and small area near Sycamore Canyon confluence.
Proterozoic(ca. 2000-1500Ma)	Gabbro(igneous)	>1,500 Ma	Xgb	Medium- to coarse-grained igneous rock. Mosty in decomposed outcrops.	Odic nature and Fe-to very Fe-rich.	Rare. Only around Rio Verde Ranch downstream to Duff spring area(ca. 9.5mi east of Paulden).
	Granodiorite of the Verde River	Ca. 1,720 Ma	Xvr	Medium-grained granite. Mosty in decomposed outcrops.	Alkali-calcic , very sodic, and very Mg rich.	Rare. Only around Rio Verde Ranch downstream to Duff spring area(ca. 9.5mi east of Paulden). Only known location of this rock.

Table 1. Geologic Era, ages, map symbols, descriptions, chemistry and abundance of important geologic elements to vegetation distribution found within the study area (From DeWitt et al. 2008).

Human History and Land Use

Pre-Columbian Occupation

The Upper Verde River region has been influenced by humans for centuries as evidenced by an abundance of pit house, pueblo and village ruins, cliff dwellings, rock art sites, and remnants of agricultural fields and irrigation canals along the river valleys and throughout tributary canyons (Figure 12) (Fewkes 1856, Fish 1976, personal observations). Archaeological sites discovered in the Verde Valley indicate paleo-indians occupied the valley as far back as 14,000 B.P. (Elias 1997).

Permanent settlements along the Upper Verde began around A.D 800 during the Pueblo I period and density gradually increased to intense inhabitation through the Pueblo IV period around 1400 A.D. Several cultures lived in the area during these periods including the Hohokam, Salado, Prescott, Tusayan and Hopi, Sinagua, and Pai (Hualapai, Yavapai, Havasupai) (Fish 1974, Neary et al. 2012). In many cases members of multiple tribes would co-habitate in the same villages (Fish 1974). The Sinagua settled in the Verde Valley around 1275 A.D. and built the extensive pueblos associated with Tuzigoot and Montezuma National Monuments. Irrigation canals began to be constructed with the first permanent settlements and extensive networks were constructed throughout the Verde Valley and in broader alluvial areas along the Upper Verde such as Perkinsville. Large terraces can be seen today that were farmed extensively.

Sites are numerous and occupy nearly every kilometer of the entire Upper Verde. Cliff dwellings exist around Duff Spring; rock art sites are frequent including Sullivan's Canyon, Cambell's Ranch and the area around Bear Siding; and extensive pueblos and pithouses abound at sites such as Duff Spring, Bull Basin, Rio Verde Ranch, Bear Siding,

Perkinsville, the headwaters area, Morgan's Ranch, Mormon's Pocket, the town of Sycamore (Figure 12), Sycamore Canyon confluence and Clarkdale (Fewkes 1856, Fish 1976, personal observations). Many plant species were used, introduced and cultivated in the area, a few of which, including the pre-Columbian domesticates *Agave phillipsiana* and *A. delamateri* exist in relict patches near archaeological sites today (Fish 1976, Hodgson and Salywon 2013).

Various tribes, especially the Apache and Yavapai occupied the Verde from the 1400s to the mid 1800s. The Yavapai-Apache had extensive seasonal settlements throughout the region but ran into increasing conflict with arrival and land occupation of settlers during the 1850s-60s until they were forced to move to the Rio Verde and San Carlos Indian Reservations in 1865 (Bykrit 2001).

Figure 12. Hilltop pre-Columbian pueblo overlooking the UpperVerde River near its confluence with Sycamore Canyon.

European and Modern Occupation

The first European recorded to have visited the Verde River was the Spanish explorer Antonio de Espejo during his explorations for mineral wealth in the areas of Jerome and Sedona. Other Spanish explorers visited around that time but the area remained mostly unvisited until the arrival of French trappers in the early 19th century (Neary et al. 2012). Many notable trappers and explorers crossed through during the 1800s until permanent settlements showed up around 1860. From that time until now various sections have been utilized for gravel mining, grazing and mineral mining and the river has been diverted and impounded in various sections. Extensive cattle ranching occurred for over a century along the Verde, based out of active local ranches such as the Perkinsville and Verde Ranches. During this time thousands of heads of cattle grazed the region, significantly reducing the cover of many grasses and forbs and compacting soils (Bykrit 2001). Cattle numbers were reduced during the 20th century and today limited numbers of herds still graze.

Watershed and Vegetation Changes

Paleoecological records indicate the Upper Verde River geomorphology and vegetation has changed considerably and repeatedly throughout history. Early explorer and settler reports from throughout the 1800s agree that the historic Upper Verde River consisted of extensive cienegas and marshy wetlands with high water tables, high humidity, and a common occurrence of malaria (Bykrit 2001, Neary et al. 2012). Neary et al. (2012) compared photographs from over 100 years at numerous sites and confirmed earlier reports of the historic Upper Verde River consisting of more extensive open cienegas, marshes, a wider, meandering, more cobble-bedded stream vertically close to

the floodplain, and streamsides mostly free of dense herbaceous vegetation or riparian deciduous forests. Repeat photography also showed a riparian corridor in flux, where periodic large-scale flood events scour vegetation, leading to open, gravelly sand bars where pioneer riparian vegetation colonizes and becomes dense over time until it is scoured out and the cycle repeats.

The most long-lasting and widespread geomorphic change has occurred with extensive arroyo cutting and river channelization due to factors such as damming in the upper watershed, various land use practices, drought and a catastrophic flood event in 1993 (Figure 13) (Neary et al 2012). A lower water table and lack of meandering channels reduced open cienegas, wetland meadows and marshes dominated by grasses, sedges and rushes.

Figure 13. Arroyo cut near Morgan's Ranch showing the Verde River ca. 4 meters below its previous level (Photo courtesy of Neary et al. 2012) .

Scouring and subsequent recruitment associated with the 1993 floods allowed establishment of a cohort of riparian trees including *Populus fremontii*, *Salix goodingii* and *Fraxinus velutina*. Channelization of the stream led to an increase in dense streamside vegetation lining much of the river today (Figures 13 and 14).

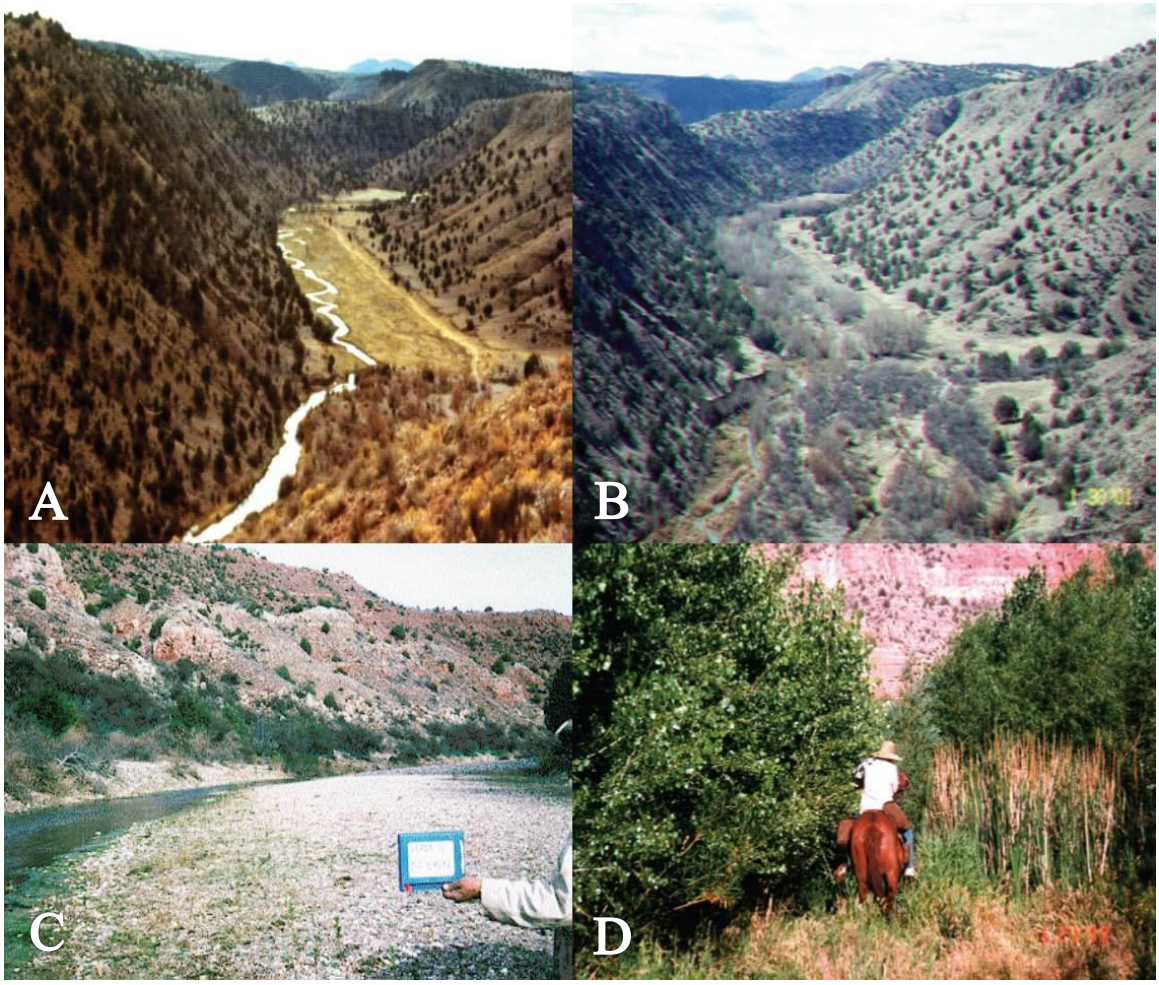

Figure 14. Repeat photography showing geomorphic and vegetation change along the Upper Verde River. A. Open, meandering stream with extensive cienega-type habitat dominated by sedges, rushes and grasses from 1979 .B. Same photopoint ca. 2001 showing encroachment of Riparian Woodlands and Shrublands. C. Open streambank and cobbly stream downstream from Perkinsville in 1979. D. Near location of C in 2001 showing dense riparian woody and herbaceous vegetation (Photos courtesy of Neary et al. 2012).

Water Use and Conservation Concern

In addition to combined watershed geomorphological and vegetation change, the river's flow itself has undergone significant changes and is predicted to change further. Long-term records of receding surface and sub-surface water levels and decades of research have led to the prediction that base flows of the Verde River will significantly decrease over coming decades (Garner et al. 2013). Goundwater levels have already decreased more than 20 m since 1940 in the Little Chino Valley Basin just a few miles from the headwater springs. As recently as the 1970s perennial flow began at Del Rio Springs, approximately 9 km upstream from where it currently begins. These decreases are linked to agricultural diversions, groundwater pumping, wells, and partially to reoccurring and prolonged droughts (Wirt and Hjalmarson 2000, Wirt et al. 2005).

In 1999, the Arizona Department of Water Resources (ADWR) declared the Prescott Active Management Area (PrAMA) no longer in safe-yield. This prompted the "Big Chino Ranch Project", involving the purchase of ranch property and associated groundwater rights north of Prescott, installation of large-scale pumps to extract water from the Big Chino Aquifer (the primary source of Verde flows), and a 40-mile pipeline to meet future water needs of the Prescott tri-cities area (City of Prescott 2011). This has led to over 10 years of city meetings, public debate, research, monitoring, and repeated injunctions against City of Prescott water managers by downstream stakeholders. A recent USGS modeling study predicts that the Big Chino Ranch Project, combined with current capture rates (includes diversions, groundwater pumping and wells) and population growth rates in the region, will deplete Verde flows by 5,400 to 8,600 acre-

feet per year over the next 100 years (Garner et al. 2013), significantly impacting downstream ecosystems and municipalities (Haney et al. 2008).

The Verde's importance to the region and threats have prompted public debate about water rights, sustainable harvest and the river's protection; and research into Verde hydrology (Wirt and Hjalmarson 2000, Wirt, 2005, Garner et al. 2013) geomorphology (Pearthree 2008) and ecology-stream flow relationships (Stevens 2008, Stromberg 2008). The Salt River Project, a major downstream stakeholder that provides water to multiple municipalities including the Phoenix metropolitan area has been in legal disputes with City of Prescott water managers which led to agreements to establish long-term monitoring and modeling by USGS (Barks 2013). Other partnerships have arisen between residents, stakeholders, environmental groups, researchers, universities and local, state and federal agencies to conduct research and develop sustainable water management and protection plans (Garner et al. 2013, VRBP 2015, Leake and Pool, 2010).

Various sections of the River have been protected by the US Forest Service and Arizona Fish and Game and through land purchases by the Nature Conservancy, private citizens and non-profit groups. The river is on watch lists for multiple environmental organizations, including the Center for Biological Diversity, and was listed as one of the top 10 most endangered rivers in the United States in 2006 by American Rivers (2006). In 2006, the upper section became eligible for Wild and Scenic designation due to a combination of cultural resources, natural and scenic values, and free flowing condition (USDA-USFS 2010), but no legal protection has been attained for either the stream or surrounding landscape.

Past Botanical Research along the Upper Verde

Although a floristic inventory has not been conducted in the area, the Upper Verde has been visited by collectors and ecologists for almost a century. Botanical exploration near the headwaters began around 1935 when H.R. Bentham made several collections. R.A. Darrow visited in 1945 but species documentation remained idle until the early 1960's when Frank Crosswhite made numerous collections near the headwaters. The prominent North American botanist Delzie Demeree and prolific Arizona botanist Elinor Lehto were other collectors during that period. In the lower section of the study reach, below the confluence with Sycamore Canyon, numerous collections were made by Lehto and Donald J. Pinkava in the late 1960s while travelling throughout Arizona collecting extensively in unvisited areas (Dr. Donald J. Pinkava, personal communication).

Many sections of the study reach remained uncollected including much of the middle sections until the 1990's when Marc Baker and Teresa Wright made hundreds of collections and documented populations of federally listed sensitive species during US Forest Service Surveys (Baker and Wright 1993, 1996). Other studies have been conducted by Kate Huisinga, who documented distributions of the US Forest service sensitive *Salvia dorrii* subsp. *mearnsii* (Huisinga 2001); Babara Phillips, retired botanist with the Coconino, Kaibab and Prescott National Forests who conducted multiple studies on rare plants in the Verde Valley (Phillips et al. 1995); and John Anderson, the previous Bureau of Land Management Arizona stete botanist who conducted multiple studies on rare plants in the area including the distribution and historical biogeography of lacustrine edaphic endemics (Anderson 1996, 2011)

CHAPTER 3

METHODS

Specimen and Data Collection

A primary goal of this study was to collect specimens of all vascular plant species to produce an annotated checklist for the Upper Verde River. Collections were made March through mid-November, over the course of three years—2011, 2012 and 2013. Approximately 165 days were spent in the field resulting in 1856 collections at 640 localities (Figure. 15). Survey routes and collection sites were chosen to maximize coverage of the study area and to survey the full variety of habitats. Routes were planned prior to field trips—using satellite imagery (https://www.google.com/earth/), USGS Geologic, hydrologic and topographic maps (DeWitt et al. 2008, Wirt et al. 2005)—and in the field by scanning the landscape and covering the maximum amount of ground within each habitat. At a field site, new taxa were collected and the landscape and its habitats subsequently explored for collections. Particularly unusual habitats such as specialized geologic formations, sandy or cobbly soils, shady and mesic sites, canyons, rocky outcrops and cliffs were searched more thoroughly and frequently as they often yielded new and interesting taxa.

An effort was made to collect at least one voucher of each taxon in the study area. A specimen was taken when a population of at least 10 plants was found in the immediate area, or when enough material could be clipped from a plant for identification. When these conditions were not met, a photo voucher was collected. Each taxon in the flora was collected or observed at a minimum frequency of ca. 15 km along the length of the study area.

At each collection locality, information was recorded on GPS coordinates, elevation, habitat characteristics (e.g., geomorphic landform, substrate such as pure sand, sandy loam, silt, gravelly loam), geologic type, slope, aspect and amount of shade), and plant features (e.g., height, flower color, growth form, habit and abundance). Specimens were placed in a plant press the same day of collection with enough material for 1-5 duplicates.

Database/Herbaria search

To make the checklist as complete as possible, I queried regional herbaria through SEINet to determine which plant taxa were previously reported for the study area (http://swbiodiversity.org/portal/index.php). This search returned over 1400 specimens of ca. 690 taxa. Inspection of every specimen was not within the scope of this study, so I reviewed the list for taxa which occur in the region but were not vouchered during this project. Many were incorrectly georeferenced, had very general localities, or were listed under synonyms. After these were removed, the species list numbered 511. I examined vouchers available at ASU or ARIZ verifying identities for many and annotating any incorrectly identified specimens.

Taxonomic identification and nomenclature

I used multiple taxonomic references to identify specimens including the most updated treatments in *Flora of North America* (http://www.efloras.org/), treatments from the Vascular Plants of Arizona Project (VPAP) (http://www.canotia.org/vpa_project.html), or various updated taxonomic, systematic or monographic treatments. For groups lacking updated treatments I used *Arizona Flora* (Kearney and Peebles 1960) and *Seed Plants of Northern Arizona* (McDougall 1973).

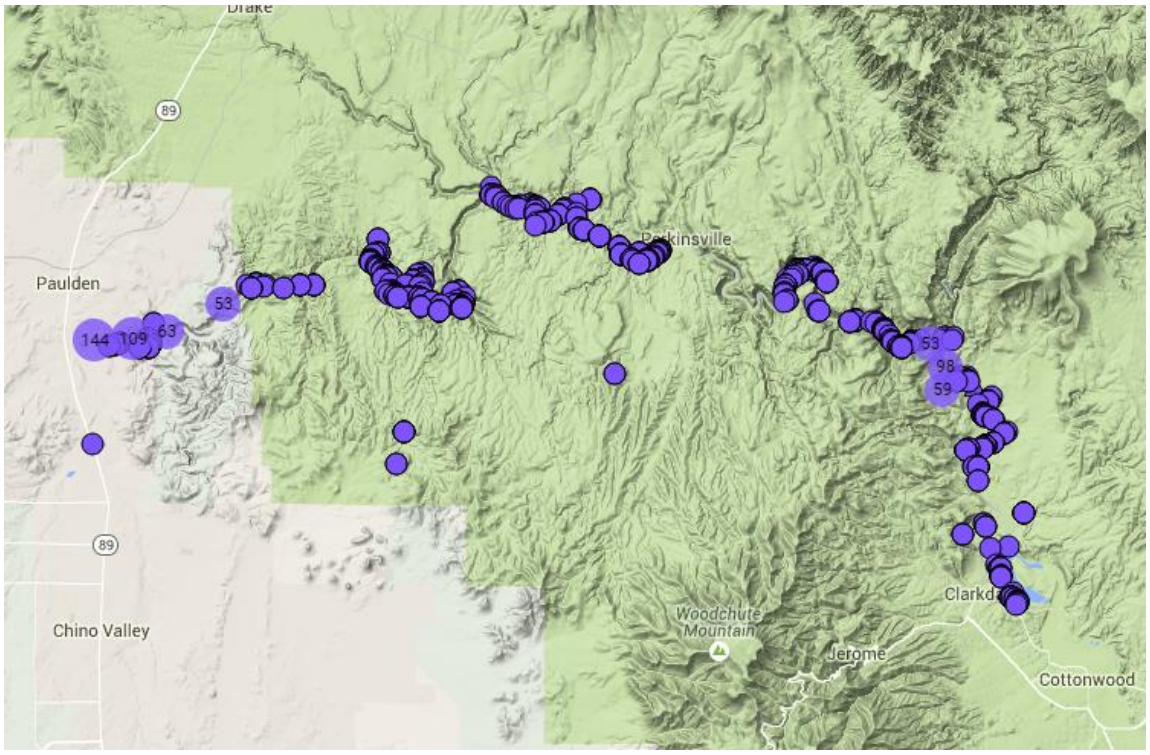

Figure 15. Map of collection localities in the Upper Verde River study area during 2011-2013.

I corroborated identifications by comparing with ASU Herbarium accessions, using those annotated by experts whenever available. Problematic specimens and notable collections were sent to experts for identification (Table 2).

Species nomenclature follows The Plant List (www.theplantlist.org), Tropicos (www.tropicos.org) and the online Integrated Taxonomic Information System (ITIS) (http://www.itis.gov/). I also followed regional trends and consulted specialists for some names. Family concepts follow the Angiosperm Phylogeny Group III (http://www.mobot.org/MOBOT/research/APweb/).

Table 2. Specialists consulted for determinations, their associated institution and their group of specialty.

Specialist	Association	Group
Marc Baker	Arizona State University (ASU)	*Echinocereus*
Curtis Clark	Cal Poly Pomona (RSA-POM)	*Encelia*
Christopher Davis	Arizona State University (ASU)	*Malvaceae, Sphaeralcea*
Mark Egger	University of Washington (UW)	*Castilleja*
Walter Fertig	Arizona State University (ASU)	Various taxa
Craig Freeman	Kansas Biological Survey (KU)	*Penstemon*
Wendi Hodgson	Desert Botanical Garden (DES)	*Yucca* and *Agave*
Leslie Landrum	Arizona State University (ASU)	*Quercus*
Max Licher	Deaver Herbarium (ASC)	*Carex, Pediomelum, Juncus*
Elizabeth Makings	Arizona State University (ASU)	*Poaceae,* various taxa
Guy Nesom	2925 Hartwood Drive Fort Worth, TX	*Erigeron, Erythranthe, Heterotheca, Solidago*
Nuri Benet Pierce	San Diego State University (SDSU)	*Chenopodium*
Glenn Rink	Deaver Herbarium (ASC)	*Carex*
Andrew Salywon	Desert Botanical Garden (DES)	*Brassicaceae*
Michael Vincent	Miami University (MU)	*Trifolium*
Stanley Welsh	Brigham Young University (BYU)	*Atriplex, Pediomelum*

Databasing and accessioning

Collection data were entered into a Microsoft Access database and uploaded to through Arizona State University Herbarium (ASU) to SEINet. At least one specimen of each collection was mounted and accessioned in the ASU Herbarium and duplicates were sent, in order of priority, to: Deaver Herbarium at Northern Arizona University (ASC), Desert Botanical Garden (DES), Rancho Santa Ana Botanic Garden (RSA) and various other herbaria with specialists in particular groups.

Annotated Checklist and Taxonomic Summaries

I generated a checklist based on my field work and previous collections and compiled the following information for each each taxon: 1) scientific name and authority; 2) common name, obtained from USDA Plants Database (http://plants.usda.gov/); 3) Native/Non-Native Status, obtained from USDA Plants; 4) duration and life form,

obtained from USDA Plants; 5) frequency, from collections, associated species lists and other observations; 6) wetland status, from the US Army Corps of Engineers Wetland Indicator List (Lichvar et al. 2014); and 7) a voucher with collector name and number .

The above data were used to summarize the number of taxa and percentage of the flora in various categories. In some cases, plants are categorized under multiple life forms. In these cases I assigned the plant to the longest-living or largest life form category. For instance, a species classified as shrub/tree was put into the tree category.

Taxa of Conservation Concern, Endemics and Notable Collections

A list of species of conservation concern was derived using data from the US Fish and Wildlife Service list of Threatened and Endangered species (USFWS 2015), the Arizona Natural Heritage Program's Heritage Data Management System (http://www.azgfd.gov/w_c/edits/species_concern.shtml), the Regional Forester's Sensitive Species List (USDA-USFS 2013), and a priority list compiled by the Southwest Rare Plant Task Force (Laurenzi and Spence 2013). A checklist of localized endemics (global range <16,500 km^2), regional endemics (global range of 16,500 - 250,000 km^2) (Fertig 2012), and taxa endemic to the state of Arizona was generated using maps of species distributions from SEINet, USDA plants, a draft distribution database of Arizona flora developed by the Southwest Rare Plant Task Force (Walter Fertig unpublished data), and a list of Arizona endemics compiled by researchers at the Desert Botanical Garden (Hodgson et al. 2013). The distribution and rarity of several other taxa of interest (e.g. range extensions, taxa rarely collected in the region) were also analyzed using species distribution maps from SEINet and Encyclopedia of Life (http://eol.org/). Definitions of categories from the above analyses are given in Appendix A.

Vegetation Communities

I categorized vegetation community types based off of my field observations, habitat notes, associated species lists and maps produced by the USGS National Gap Analysis Program (GAP) and Brown (1982). Due to inconsistencies between categorization schemes and on the ground observations, I combine the two classification schemes, using their definitions in some instances and my own in others.

Factors influencing species richness and composition

I discuss four factors influencing the composition and richness of the flora: 1) adjacency of four floristic provinces; 2) complex topography and habitat types; 3) diversity of geologic formations; and 4) human introductions both from pre-Columbian and modern time. Species' floristic affinities were analyzed by visually inspecting SEINet distribution maps. Based on their primary distribution, each taxon was assigned to one of three floristic affinities of the southwest defined by McLaughlin (1992)—the Intermountain, Sonoran or Madrean. The effect of topography and habitat diversity was gathered from field notes and observations. Affinities to specific geologic and soil types were analyzed by reviewing collections, associated species, and habitat data collected in the field and assigning each species to a particular substrate type when a majority of their occurrences were restricted to that category (e.g. limestone, igneous, basalt). The effect of modern humans on the flora was gathered from USDA Plants information on Native and Introduced taxa. The potential for some species having been used or introduced by pre-Colombians was gathered through field observations of species' association with archaeological sites, SEINet distribution maps, and literature review.

CHAPTER 4

RESULTS

Taxonomic Summaries

General

A total of 1856 collections were made in the Upper Verde study area in 2011-2013, representing 696 taxa. An additional 33 taxa are identified from the area based on past collections in regional herbaria, resulting in a total flora of 729 taxa. The flora includes 672 species, 56 infraspecific taxa and 1 hybrid in 404 genera and 98 families (Tables 3 and 4, Appendix B). Prior to this study, only 419 vascular plant species (and 1400 specimens) had been recorded for the Upper Verde according to SEINet, thus 310 taxa were added to the known flora.

The most species rich family is Poaceae (112 spp., 16% of the flora) followed closely by Asteraceae (108 spp., 15% of the flora). Other families, in order of importance, are Fabaceae, Brassicaceae, Amaranthaceae, Boraginaceae, Euphorbiaceae and Cyperaceae (Table 4). The most species rich genera in the flora are *Euphorbia* (16 taxa), *Eriogonum* (10 taxa) and *Astragalus* (9 taxa) (Table 4).

Growth Forms

The most represented growth form in the flora are the perennial forbs (203 spp., 28% of the flora) while the ferns are least represented (7 spp., < 1% of the flora) (Table 5). Although the most abundant and conspicuous growth forms on the landscape are the trees, shrubs and grasses, they fall far behind the forbs in terms of number of species (Table 5).

Table 3. Taxonomic and special category summaries for the Upper Verde flora. Definitions and data sources are listed in Appendix A.

List by Taxonomic Category		Special Category	# Taxa	% Total Flora
Families	98	Native	632	87
Genera	404	Non-Native	97	13
Species	672	Localized Endemics	9	1
Infraspecific Taxa	56	Regional Endemics	39	5
Hybrids	1	Arizona Endemics	17	2
Total Taxa	729	Total Endemics	48	7
		Forest Service Sensitive	7	1
		Arizona Natural Heritage Program List	57	8
		Heritage Program Tracking	26	4
		Federally Threatened or Endangered	1	<1

Table 4. Most species-rich families and genera along the Upper Verde River.

Family	#Taxa	% Total Flora	Genus	Family	# Taxa
Poaceae	112	15	*Euphorbia*	Euphorbiaceae	16
Asteraceae	108	15	*Eriogonum*	Polygonaceae	10
Fabaceae	48	7	*Astragalus*	Fabaceae	9
Brassicaceae	25	3	*Amaranthus*	Amaranthaceae	8
Amaranthaceae	25	3	*Cryptantha*	Boraginaceae	8
Boraginaceae	22	3	*Oenothera*	Onagraceae	8
Euphorbiaceae	21	3	*Penstemon*	Plantaginaceae	8
Cyperaceae	20	3	*Dalea*	Fabaceae	7
Polygonaceae	18	2	*Eragrostis*	Poaceae	7
Plantaginaceae	17	2	*Juncus*	Juncaceae	7
Lamiaceae	16	2	*Muhlenbergia*	Poaceae	7
Solanaceae	15	2			
Polemoniaceae	13	2			
Apocynaceae	12	2			
Nyctaginaceae	12	2			
Onagraceae	12	2			
Cactaceae	11	2			
Asparagaceae	10	1			
Rosaceae	10	1			

Wetland Flora

Forty nine obligate wetland taxa (those dependent on wetland soils) occur along the Upper Verde (44 native, 5 non-native) (Table 6). Another 45 are facultative wetland taxa (37 native, 8 non-native), mostly relying on wetlands but capable of occurring in non-wetland areas. Sixty four are facultative (47 native, 17 non-native), occurring in wetlands and non-wetlands but field observations indicate most of these taxa are restricted to the riparian zone in the study area. Eighty five are facultative upland taxa (56 native, 29 non-native), generally defined as usually occurring in uplands. In the study area many of these species were mostly found in riparian areas. In summary a total of 269 taxa, 37% of the flora are either dependent on the Verde River, primarily rely on conditions of the riparian corridor, or are found in riparian areas (Table6). Many more un-categorized species volunteer in the riparian corridor thus the species richness facilitated by wetlands and the riparian corridor is higher than this estimate.

Introduced Taxa

Within the flora, 97 (13%) are non-native. The percent non-native species in the flora of Arizona is around 12% (Walter Fertig unpublished data) indicating the Upper Verde is equal to slightly higher than the state average. Several species listed as noxious weeds in Arizona occur such as *Lepidium draba, Onopordum acanthium,* and *Rhaponticum* (*Acroptilon*) *repens.* Introduced species targeted by invasive species management occur in isolated but sometimes dense patches and include *Ailanthus altissima, Tamarix chinensis, Arundo donax* and *Elaeagnus angustifolia*. Targeted noxious and invasive species are limited in the area, occurring in isolated, yet sometimes dense patches. Other introduced species such as *Bromus rubens, B. diandrus, B.*

tectorum, Cynodon dactylon and *Melilotus officionalis* are ubiquitous and dominate groundcover in many riparian areas.

Table 5. Number of taxa in each life form category and their percent of the flora. Categories follow USDA-NRCS (http://plants.usda.gov) and definitions are in Appendix A.

Life form	# Taxa	% Total Flora
Annual Forb/Herb	191	26
Perennial Forb/Herbs	203	28
Biennial Forb/Herbs	8	1
Total Forbs	**402**	**55**
Annual Graminoids	39	5
Perennial Graminoids	101	14
Total Graminoids	**140**	**19**
Subshrubs	53	7
Shrubs	49	7
Vines	25	3
Trees	37	5
Succulents	16	2
Ferns	7	1

Table 6. Number of riparian taxa and their percent of the Upper Verde River flora. Indicator categories follow Lichvar et al. (2014) and native status follows USDA-NRCS categories (http://plants.usda.gov). Definitions are in Appendix A.

Wetland Indicator Status	# Taxa	% Total Flora
Native Obligate Wetland	44	6
Non-Native Obligate Wetland	5	1
Total Obligate Wetland	**49**	**7**
Native Facultative Wetland	37	5
Non-Native Facultative Wetland	8	1
Total Facultative Wetland	**45**	**6**
Native Facultative	63	9
Non-Native Facultative	27	4
Total Facultative	**90**	**12**
Native Facultative Upland	56	8
Non-Native Facultative Upland	29	4
Total Facultative Upland	**85**	**12**
Total Native Riparian Taxa	200	27
Total Non-Native Riparian Taxa	69	9
Riparian taxa of conservation concern(<G5)	18	2
Total Riparian Taxa	**269**	**37**

Endemics and species of conservation concern

The Verde Valley has the 4th highest concentration of endemics in the state (Hodgson et al. 2013). The Verde River region has long been known to harbor a number of rare taxa and species of interest (Phillips et al. 1995, Baker and Wright 1993, 2014; Anderson 1996) and continues to be an area of discovery as three new species were described in the past five years (Welsh and Licher 2010, Hodgson and Salywon 2013). I identify several regional endemics and taxa of concern that were not known previously from the Upper Verde River. Several are US Forest Service sensitive species and taxa on the Arizona Natural Heritage Program watch list (Table 7). Thirty nine are regional endemics and 9 are localized endemics for a total of 48 endemic taxa, 17 of which are endemic to the state of Arizona (Table 8). Twenty-six taxa are on the Arizona Natural Heritage Program watch list, 7 are US Forest Service Sensitive (USDA-USFS 2013), and 4 are considered high or very high priority for protection by the Southwest Rare Plant Task Force (Laurenzi and Spence 2013). Sixteen species on the Heritage list are either obligate or facultative wetland plants.

Table 7. Arizona Natural Heritage Program list of plants of concern along the Upper Verde River, extracted from the Heritage Data Management System (HDMS 2015). Taxa <S3 and wetland plants are included. Also shown are geographic distribution (SEINet 2015 and Fertig unpublished data); Natureserve (2015) global and subnational rank, AZ Heritage program tracking status (HDMS 2015); USFS Sensitive status (USDA-USFS 2013); and priority ranking per the Southwest Rare Plant Task Force (Laurenzi and Spence 2013). Category definitions are in Appendix A.

Taxon	Family	Geographic Distribution	Global Rank	State Rank	2015 AZ Heritage Tracking	2013 USFS Sensitive	SW Rare Plant Task Force	Wetland Status
Abronia nana	Nyctaginaceae	Reg Endemic	G4	S1				
Agave delamateri	Asparagaceae	Loc Endemic	G2	S2	X	X	Very High	
Agave phillipsiana	Asparagaceae	Loc Endemic	G1?	S1	X	X	Very High	
Alisma triviale	Alismataceae	Widespread	G5	S4				OBL
Anemopsis californica	Saururaceae	Widespread	G5	S3	watch			OBL
Aquilegia chrysantha	Ranunculaceae	Widespread	G4	S3				FAC
Astragalus newberryi	Fabaceae	Widespread	G5	S1				
Berula erecta	Asteraceae	Widespread	G4G5	S3	watch			OBL
Bidens aurea	Asteraceae	Widespread	G5	S3S4				OBL
Bidens laevis	Asteraceae	Widespread	G5	S2S3	X			OBL
Carex hystericina	Cyperaceae	Widespread	G5	S3	watch			OBL
Carex pellita	Cyperaceae	Widespread	G5	S4?				OBL
Carex senta	Cyperaceae	Widespread	G5	S3S4				OBL
Carex vulpinoidea	Cyperaceae	Widespread	G5	S2S3	X			OBL
Cylindropuntia whipplei	Cactaceae	Reg Endemic	G4	S1				
Cyperus squarrosus	Cyperaceae	Widespread	G5	S4				OBL
Echinocereus fasciculatus	Cactaceae	Reg Endemic	G4G5	S3	watch			
Eleocharis rostellata	Cyperaceae	Widespread	G5	S3	watch			OBL
Epipactis gigantea	Orchidacae	Widespread	G4	S3S4				OBL
Eremogone aberrans	Caryophyllaceae	Reg Endemic	G2	S2	X		Likely Stable	
Eriogonum ripleyi	Polygonaceae	Loc Endemic	G2	S2	X	X	High	
Escobaria missouriensis	Cactaceae	Widespread	G5	S3	watch			
Hedeoma diffusa	Lamiaceae	Loc Endemic	G3	S3	X	X		
Heterotheca zionensis	Asteraceae	Reg Endemic	G2G3Q	S2	X			
Juncus articulatus	Juncaceae	Widespread	G5	S3	watch			OBL
Lotus mearnsii	Fabaceae	Reg Endemic	G3	S3	watch			
Mentzelia longiloba var. yavapaiensis	Loasaceae	Reg Endemic	G5	S2S3	X			
Packera quercetorum	Asteraceae	Reg Endemic	G4	S4				
Pectis rusbyi	Asteraceae	Widespread	G3G4	S3	watch			
Pediomelum verdiense	Fabaceae	Loc Endemic	G1?	S1	X	X		
Penstemon ophianthus	Plantaginaceae	Widespread	G3G4	S3	watch			
Phemeranthus parviflorus	Montiaceae	Widespread	G5	S3	X			
Physalis solanacea	Solanaceae	Widespread	G4?	S2S3	X			
Purshia subintegra	Rosaceae	Loc Endemic	GNA	S2	X			
Ranunculus cymbalaria	Ranunculaceae	Widespread	G5	S4				OBL
Rhinotropis rusbyi	Polygalaceae	Loc Endemic	G3	S3	X	X		
Salix gooddingii	Salicaceae	Widespread	G5	S4				FACW
Salvia dorrii subsp. mearnsii	Lamiaceae	Loc Endemic	G5T3	S3	X	X	High	
Sicyos laciniatus	Cucurbitaceae	Widespread	G4?	S?	X			
Trichostema brachiatum	Lamiaceae	Disjunct	G5	S4				

Table 8. Endemics in the Upper Verde River Flora. Endemic category is listed for each taxon (regional, localized) after Fertig (2012), where a localized endemic = global range of <16,500km^2 and a regional endemic = a global range of 16,500 -250,000km^2. Arizona endemics are after Hodgson et al. (2013).

Taxon	Family	Endemism	Arizona Endemic
Acmispon (Lotus) mearnsii	Fabaceae	Regional	
Agave delamateri	Asparagaceae	Localized	X
Agave phillipsiana	Asparagaceae	Localized	X
Alnus oblongifolia	Betulaceae	Regional	
Amsonia palmeri	Apocynaceae	Regional	
Asclepias involucrata	Apocynaceae	Regional	
Astragalus lentiginosus var. *wilsonii*	Fabaceae	Regional	X
Astragalus subcinereus	Fabaceae	Regional	
Canotia holacantha	Celastraceae	Regional	X
Cordylanthus laxiflorus	Orobanchaceae	Regional	
Cordylanthus parviflorus	Orobanchaceae	Regional	
Cylindropuntia whipplei	Cactaceae	Regional	
Dieteria asteroides var. *glandulosa*	Asteraceae	Regional	
Echinocereus fasciculatus	Cactaceae	Regional	X
Encelia virginensis	Asteraceae	Regional	
Eremogone aberrans	Caryophyllaceae	Regional	X
Eriogonum heermannii var. *argense*	Polygonaceae	Regional	
Eriogonum ripleyi	Polygonaceae	Localized	X
Fraxinus anomala var. *lowellii*	Oleaceae	Regional	
Funastrum cynanchoides subsp. *cynanchoides*	Apocynaceae	Regional	
Gomphrena caespitosa	Amaranthaceae	Regional	
Hedeoma diffusa	Lamiaceae	Localized	X
Heterotheca zionensis	Asteraceae	Regional	
Hymenothrix loomisii	Asteraceae	Regional	X
Juniperus arizonica	Cupressaceae	Regional	
Marah gilensis	Cucurbitaceae	Regional	
Mentzelia longiloba var. *yavapaiensis*	Loasaceae	Regional	X
Mirabilis coccinea	Nyctaginaceae	Regional	
Packera quercetorum	Asteraceae	Regional	
Pediomelum verdiense	Fabaceae	Localized	X
Penstemon eatonii subsp. *exsertus*	Plantaginaceae	Regional	X
Penstemon linarioides subsp. *sileri*	Plantaginaceae	Regional	
Penstemon ophianthus	Plantaginaceae	Regional	
Penstemon pseudospectabilis subsp. *connatifolius*	Plantaginaceae	Regional	
Peritoma jonesii	Cleomaceae	Regional	
Perityle ciliata	Asteraceae	Regional	X
Phacelia bombycina	Boraginaceae	Regional	
Physalis neomexicana	Solanaceae	Regional	
Physaria arizonica	Brassicaceae	Regional	
Physaria cinerea	Brassicaceae	Regional	X
Platanus wrightii	Platanaceae	Regional	
Pursia subintegra	Rosaceae	Localized	
Quercus palmeri	Fagaceae	Regional	
Rhinotropis (Polygala) rusbyi	Polygalaceae	Localized	X
Salvia dorrii subsp. *mearnsii*	Lamiaceae	Localized	X
Senecio eremophilus var. *macdougalii*	Asteraceae	Regional	
Yucca angustissima	Asparagaceae	Regional	
Yucca elata var. *verdiensis*	Asparagaceae	Localized	X

Notable Taxa: Abundance and Habitats

Endemics and Taxa of Conservation Concern

Following are descriptions of new populations, abundance and habitats of Forest Service Sensitive, Threatened/Endangered taxa, and a subset of rarely collected endemics found during this study. For further detail on rare taxa of the Upper Verde region not discussed here, see Tables 7 and 8, Appendix C, Baker and Wright 1993, Baker 2014, and Anderson 1996.

Forest Service Sensitive

Agave delamateri (Asparagaceae) - pre-Columbian domesticate in relict populations at prehistoric sites in the Verde Valley, Sierra Anchas, Tonto Basin and Globe area (Hodgson and Slauson 1995). Populations occur at two locations along the Upper Verde between Sycamore Canyon and Tuzigoot National Monument. No new populations were found during this study although further searching around dense archaeological areas upstream from Sycamore Canyon is advised.

Agave phillipsiana (Asparagaceae) - pre-Columbian domesticate at prehistoric sites in the Grand Canyon, Verde Valley and Hassayampa River south of Prescott. It is found along the Upper Verde at the same two locations as *A. delamateri.* No new populations were found in 2011-2013, although further searching of archaeological areas near the Verde Valley may yield localities.

Eriogonum ripleyi (Polygonaceae) - limited to four localities in central Arizona and along the Upper Verde near Bear Siding on sandy-gravelly soils and on white limestone soil exposed from the Government Mine. Two previously documented populations were observed with ca. 30-80 individuals each.

Hedeoma diffusa (Lamiaceae) - endemic to limestone and sandstone rims and canyon slopes south of Flagstaff including Sycamore and Oak Creek Canyons. There is one collection in the study area by Baker (*9004*) in Sycamore Canyon but no additional localities were found. More thorough searches along rocky rims near Sycamore Canyon and Mormon Pocket may yield others.

Pediomelum verdiense (Fabaceae) – localized endemic previously known only from limestone outcrops in the Verde Valley (Figure 16). Specimens from this study were identified by Dr. Stanley Welsh of Brigham Young University as *Pediomelum pauperitense* (Welsh and Licher 2010), a species previously known only from east of Lake Mead on the Arizona Strip, but now being combined with *P. verdiense* as part of a revision in preparation for the *Flora of North America* (Egan 2014). I found new localities near Rio Verde Ranch and the Bear Siding/Government Mine area in the central section of the study area expanding the known range approximately 56 km (35 mi) to the northwest of the type population. Several populations were found ranging from a few individuals to hundreds of plants on flat ground to gentle slopes in soft, gravelly soils derived from Martin formation dolostone, Redwall limestone, and soft, decomposed granite in pinyon/juniper woodlands. It was locally abundant along roadsides and seemed to thrive in disturbed areas. Populations were found in a different habitat than what is known for *P. verdiense* and are somewhat intermediate in characters with populations previously treated as *P. pauperitense* (Welsh and Licher 2010) and may fill gaps in the range of variation of a complex spanning central Arizona.

Purshia subintegra (Rosaceae) – Federally listed as Endangered, highly restricted to lacustrine limestone outcrops near Horseshoe Reservoir and in the Verde Valley,

including just of south of the study area. No new populations were encountered though additional surveys of Verde formation limestone north of Clarkdale may be productive.

Rhinotropis (*Polygala*) *rusbyi* (Polygalaceae) – endemic to central Arizona from Horseshoe Reservoir northwest along the Verde River valley to the Peach Springs area occurring mainly on sandstone and limestone soils (Figure 16). It was previously uncollected along the Upper Verde until I found nine new localities from the headwaters to Perkinsville on gentle slopes and mesas in exposed gravelly dolostone and limestone-derived soils. Populations ranged from a few individuals to ~50 plants.

Salvia dorrii subsp. *mearnsii* (Lamiaceae) – endemic to the Verde Valley and Upper Verde River in sandstone and limestone (Figure 16). Previous surveys (Baker and Wright 1996, Huisinga 2001) identified ca. four population centers in the Upper Verde study area. I documented two new localities near Duff Spring and ca. 6 km downstream from the headwaters where plants were locally common on mesas and hillsides in Martin Formation dolostone-derived rocky, gravelly soils.

Figure 16. Taxa of conservation concern along the Upper Verde River. A & B. *Pediomelum verdiense* on soft decomposed granite and limestone near Rio Verde Ranch. C. *Rhinotropis(Polygala) rusbyi* on Martin formation dolostone near the headwaters. D & E. *Salvia dorrii* subsp. *mearnsii* near Rio Verde Ranch.

Notable Regional Endemics

Abronia nana (Nyctaginaceae) – (Figure 17) ranges from the Great Basin Desert of Nevada into the Colorado Plateau Desert of central Utah but was previously undocumented along the Upper Verde. I found a population of ca. 30-50 individuals west of the headwaters in a small area on gentle slopes of exposed, soft, gravelly limestone and dolostone-derived soils. Together with a locality five miles north (*Wright 1254*), this population extends its range in Arizona over 70 miles to the south from the Grand Canyon region.

Astragalus subcinereus (Fabaceae) – restricted to southern Utah, eastern Nevada and the Arizona Strip. Five collections from the Verde Valley region are separate from its main center on the Kaibab Plateau ~140 km north. I found the first locality along the Upper Verde, a small population of around five plants in a shady, sandy riparian area in the Black Canyon north of Clarkdale.

Eremogone aberrans (Caryophyllaceae) – (Figure 17) restricted to central and northern Arizona in pine forests at higher elevations than the Upper Verde. Hundreds of plants were found on shady slopes in coarse granitic soils along an approximate 3 km section near Rio Verde Ranch, the first localities along the Verde River. No other populations were found despite their being ample similar habitat in limestone soils.

Gomphrena caespitosa (Amaranthaceae) – (Figure 37) primarily restricted to the Madrean Archipelago of southeastern Arizona, southwest New Mexico and northwestern Mexico with isolated populations around Payson and south of Prescott. It was previously undocumented in the Verde Valley and Upper Verde River but I found a population of

hundreds of plants in granitic soils near Rio Verde Ranch, establishing its northern range limit.

Hordeum arizonicum (Poaceae) – restricted to12 widely scattered localities primarily in Arizona and only collected once in central Arizona and Yavapai County before this study. I found two localities with small populations, both on sandy floodplains.

Penstemon ophianthus (Plantaginaceae) – (Figure 17) an endemic primarily of the Colorado Plateau, four localities were previously known from Yavapai County, none of which were along the Upper Verde. I located several populations in gravelly limestone and basalt-derived soils on flats and hillsides near the headwaters, establishing the current southwestern range limit for the species.

Physaria arizonica (Brassicaceae) – (Figure 17) restricted to northwest Arizona, southwest Utah and two other localities in Yavapai County. Two populations were found near the headwaters where it was locally common in gravelly dolostone and limestone derived soils on mesas near canyon rims. The Upper Verde collections lie along its current southern range limit.

Physaria cinerea (Brassicaceae) – endemic primarily to central Arizona with a few isolated populations in northern Arizona, the Verde Valley is its center of distribution. It was previously uncollected along the Upper Verde until I found more than 12 localities in washes, rims and slopes of canyons in sandy and limestone-derived soils.

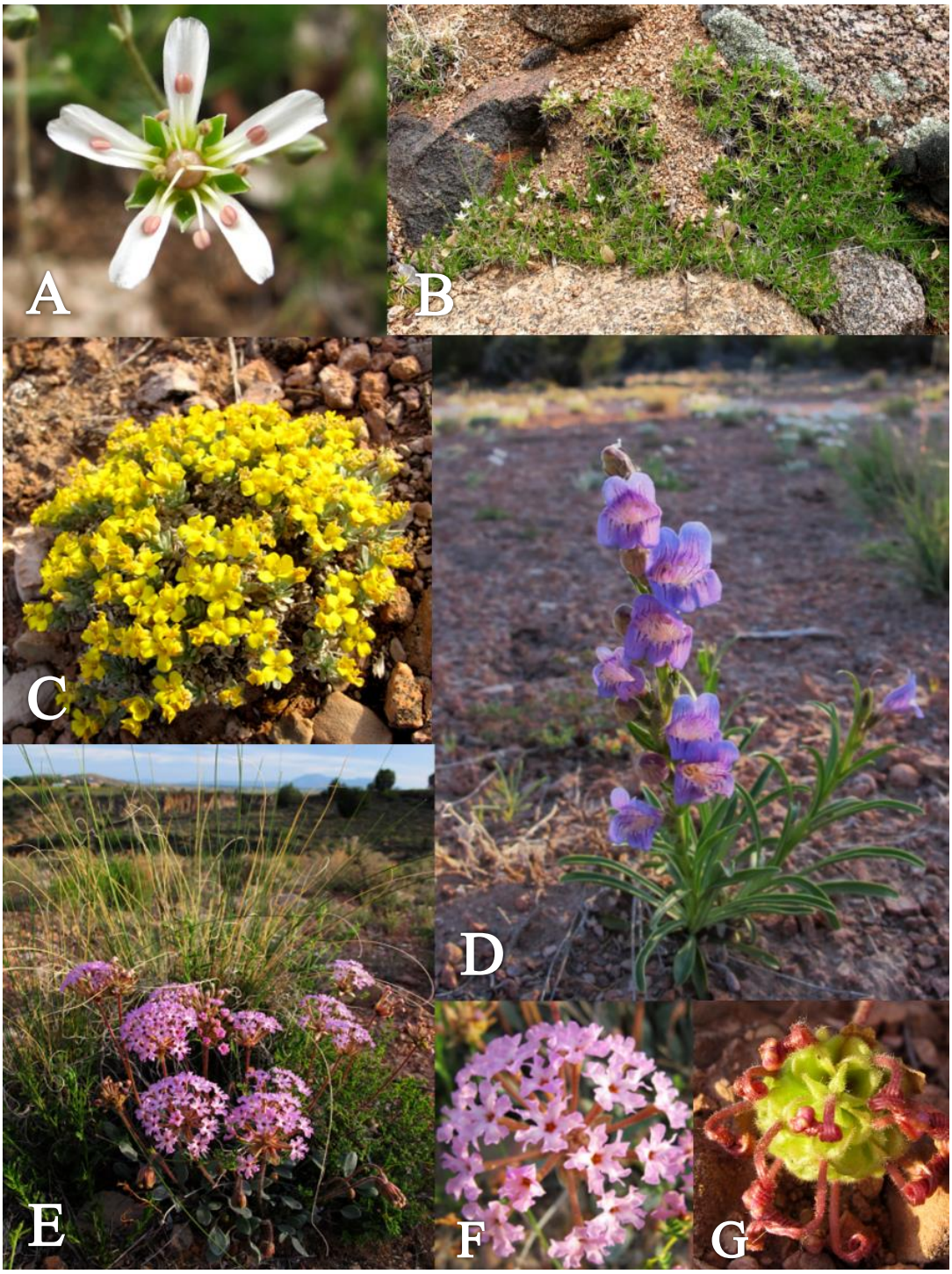

Figure 17. Regional endemics. A and B. *Eremogone aberrans* on granitic soils near Duff Spring. C. *Physaria arizonica* on Martin Formation dolostone near the headwaters. D. *Penstemon ophianthus* on dolostones near the headwaters.E-G. *Abronia nana* on Martin Formation dolostone near the headwaters.

Yucca elata var. *verdiensis* (Asparagaceae) – localized endemic with isolated populations in the Verde Valley, eastern Mogollon Rim, and Grand Canyon. It was previously collected around Peck's Lake but I found it to be occasional from Clarkdale north to Sycamore Canyon in the rolling grasslands above Black Canyon.

Range Extensions

A valuable outcome of an inventory may be the documentation of range extensions, including state and county records. I found plants from all of these categories including one new state record, three new county records, three other significant records for the county (taxa not recorded for the county in over 35 years), and several range extensions, some of which are discussed here. Introduced or non-native taxa are marked with an asterisk in the following sections.

State Records

Argythamnia mercurialina (Euphorbiaceae) – (Figure 18) a state record pending more review of specimens and records for Arizona. It was treated in *Arizona Flora* (Kearney and Peebles 1960), is listed by USDA Plants, and Nature Serve (http://explorer.natureserve.org) for the state but no specimens or records could be found. Along the Verde a few plants were documented in one locality south of Paulden in a disturbed area between boulders beside inactive railroad tracks and Old Highway 89A. It is otherwise disjunct over 450 miles from eastern New Mexico. The fact that it was only found near a railroad on the side of a highway indicates it could have been introduced by one of these routes.

County Records

Amaranthus crassipes (Amaranthaceae) – of unknown origin occurring in South America, Mexico, the West Indies, East Asia (http://eol.org/) and dispersed throughout Arizona at nine localities. My collection represents the first in Yavapai County although it seems to be fairly widespread yet rare throughout Arizona. This cryptic taxon may be more common, potentially being overlooked in the field and herbarium and resembling the more common *A. albus.* It was found in a disturbed area near Sullivan's Canyon upstream from the headwaters.

Euphorbia indivisa (Euphorbiaceae) – (Figure 18) primarily a southeastern Arizona and northwestern Mexico species ranging into southern Mexico. My collections represent a range extension of over 241 km north. It was found at three localities—in coarse granitic soils on hillsides near Rio Verde Ranch, where it was locally common and on gravelly, cobbly floodplains near Perkinsville and in the Verde Valley where it was sparse.

**Trifolium fragiferum* (Fabaceae) – found throughout the western US primarily farther north and known from only three other localities in Arizona. It is introduced and may either be increasing in range or overlooked, being mistaken for the more frequent *T. repens.* It was collected twice along the banks of the Upper Verde where it was locally abundant.

Other significant records for Yavapai County

Androstephium breviflorum (Asparagaceae) – (Figure 18) geophyte distributed from California northeast through Utah and western Colorado. The only previous record for Yavapai County was near Beaver Creek in 1970 (*Neff 27-9*). I found one population

of ~30 plants near Duff Spring on a flat hilltop in dolostone-derived rocky, gravelly sandy loam. It may have been overlooked in the region being an early spring ephemeral that resembles *Dichelostemma capitatum* after drying.

Phaseolus acutifolius var. *latifolius* (Fabaceae) – (Figure 38) significant as the first collection of the species in Yavapai County since Van Gorder (*34*) found it in the lower Verde Valley in 1962. "Tepary bean" has a long history of cultivation and wild harvest by prehistoric and current cultures throughout the southwest and south throughout the Americas (Nabhan and Teiwes 1983, Fish 2004). Two localities were found along the Upper Verde in dense archaeological areas, representing a disjunct distribution of 125 km from Mount Ord and the Tonto Basin, another prehistoric cultural center. Agave was traded between the two indicating this variety may have been carried along the same routes (Parker et al. 2007). A small patch was found on a cobbly floodplain near Perkinsville and it was also abundant in patches along north and west-facing basalt cliffs in the Black Canyon of the Verde Valley.

Phyla cuneifolia (Verbenaceae) – Primarily occurring on the Colorado Plateau, New Mexico and Colorado, and last collected in Yavapai County on the lower Verde River in 1976. It was found at over 10 localities and was locally abundant on sandy, cobbly floodplains from the headwaters to the Verde Valley.

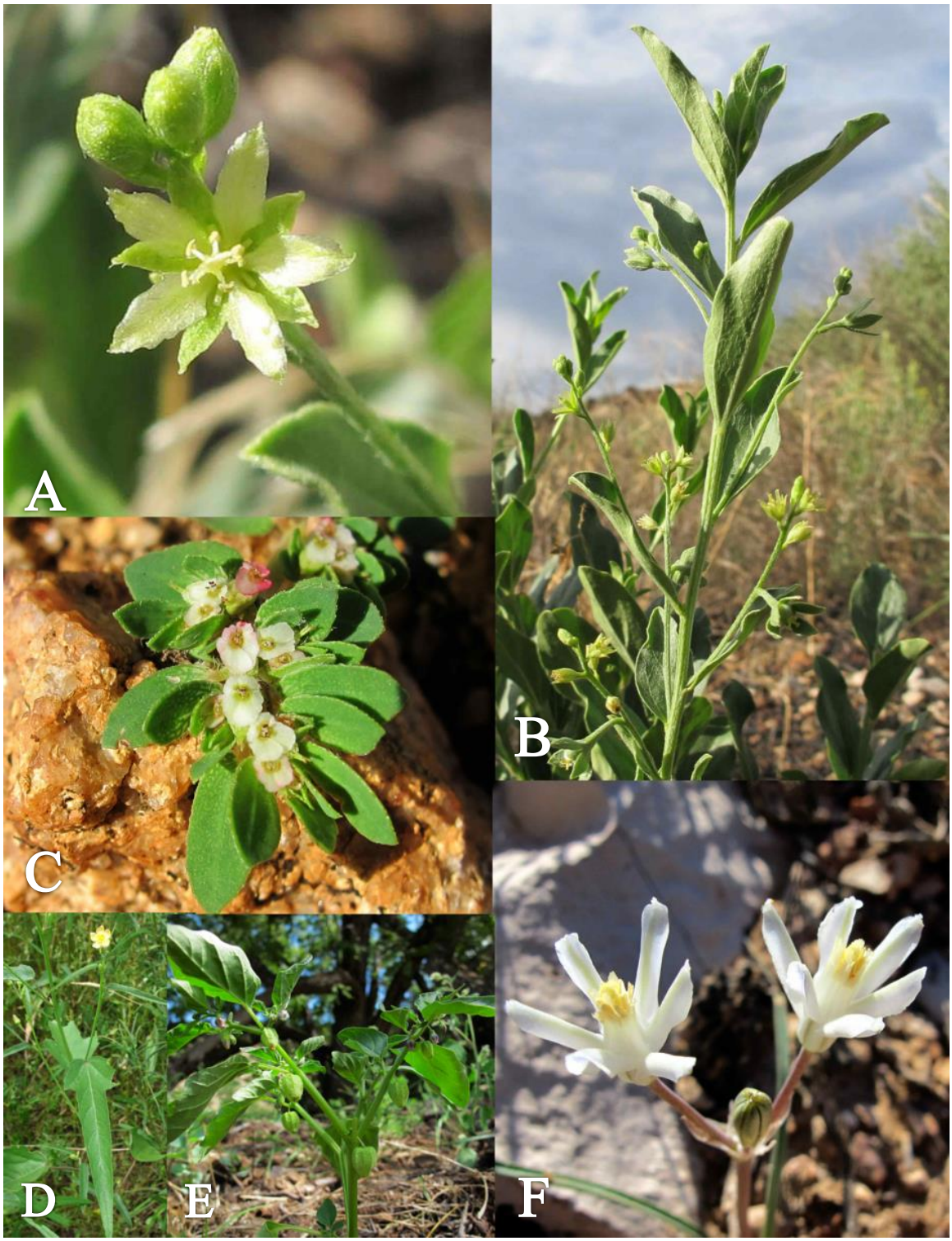

Figure 18. Range Extensions. A and B. Arizona state record *Argythamnia mercurialina*.C. New Yavapai County record *Euphorbia indivisa*. D. Northern range extension *Anoda pentachista*. E. *Physalis solanacea* along the Verde at its northern range limit. F. *Androstephium breviflorum*, rare in the region.

Other Range Extensions

Anoda pentaschista (Malvaceae) – (Figure 18) primarily found in southeastern Arizona, throughout Sonora, and collected in four localities in southern Yavapai County. Three collections made on basalt mesas during this study extend its northwestern range by approximately 72 km.

Pectis rusbyi (Asteraceae) – This Heritage Watch List species ranges from central Arizona to northern Mexico. It was previously collected at numerous Verde Valley localities but not the Upper Verde. It was abundant in various habitats along the entire study reach, forming fields of yellow after above-average monsoons. These collections extended its northwestern range limit over 64 km.

Physalis solanacea (Solanaceae) – (Figure 18) primarily of southeastern Arizona with isolated locations in central Arizona yet previously uncollected in the Upper Verde region. I found ca. 10 localities on riparian terraces in mesquite and riparian woodlands. In some places it was locally abundant after wet monsoons. My three collections represent the current northern range limit.

Rhynchosida physocalyx (Malvaceae) – primarily of southeastern Arizona and northwestern Mexico and not common farther north. My collection of a small population on a sandy flat in the Verde Valley establishes the northern range limit for the species. Together with two nearby collections by McDougall in 1956 and Thornburg (*989*) in 2013 these are the only records for Yavapai County and extend its range 190 km north.

Schistophragma intermedia (Plantaginaceae) – (Figure 37) primarily occurs in southeastern Arizona and northwestern Mexico with isolated populations in central Arizona. The Upper Verde population, found on steep slopes in granitic soils, extends its

range 70 km to the northwest from isolated collections in the lower VerdeValley and marks the northwestern range limit for the species.

Other Noteworthy Taxa

The following taxa are not under the above categories yet noteworthy for being rarely collected in the state or region. Some are habitat-specific or limited to isolated localities, making them candidates for conservation attention, while others have only been recently detected, indicating potential recent introductions. Of primary significance are wetland taxa that would lose significant portions of their range or entire populations if Verde water levels decrease, and plants of specific substrate types which cover small areas and are vulnerable to land use or expanding development.

Undercollected Wetland and Riparian Taxa

**Atriplex patula* (Amaranthaceae) – ranges from Utah north to Wyoming but only recorded twice in Arizona before this study in Apache County and Verde Valley. My Upper Verde collections and one from the Verde Valley (*Licher 307*) represent the only records for the county. I found three remote localities in shady mesic riparian floodplains where it was moderately abundant. These populations are of an unusual prostrate, large-leaved variant that does not fit into the general description for the species (Stan Welsh, pers. comm. 2015).

Bidens aurea (Asteraceae) – distributed from southeastern Arizona through Mexico, with ten localities in central Arizona. One small population (< 10 plants) was found in moist soil by the stream in Perkinsville. This collection and one by Baker near the headwater springs (*11226*), are the only collections in central/northern Arizona post-1975.

Bidens laevis (Asteraceae) – (Figure 19) occurs in California, the eastern US and is common throughout Mexico and southern Arizona though uncommon in the central/northern part of the state, being restricted to perennial sections of the Verde River, Tonto Creek, White River and Benny Creek. Along the Upper Verde it occurs at roughly ten localities where it ranges from sparse to abundant, creating showy yellow thickets along the stream.

**Cortaderia selloana* (Poaceae) – a large bunchgrass used in landscaping and listed as invasive in states where it has escaped and established large, dense stands (USDA 2015). It has been found in three other localities in Arizona outside of cultivation. Along the Upper Verde, small populations (< 5 plants) occur near the stream at Perkinsville and Clarkdale.

Lycopus asper (Lamiaceae) – (Figure 19) widespread from New Mexico north to Canada but rare in Arizona, only having been found at two localities—along the Upper Verde River and in eastern Arizona prior to 1945. Along the Upper Verde it was encountered at three locations where it was occasional to locally abundant along riffle sections of the stream.

Scutellaria lateriflora (Lamiaceae) – (Figure 19) distributed throughout the Midwest, eastern US and narrowly restricted in Arizona to the Upper Verde, Oak Creek and two pre-1970 collections near Pinetop-Lakeside. The Arizona populations are disjunct over 850 km to the Texas panhandle. Along the Upper Verde it is frequent to locally abundant along stream banks in the Black Canyon section north of Clarkdale.

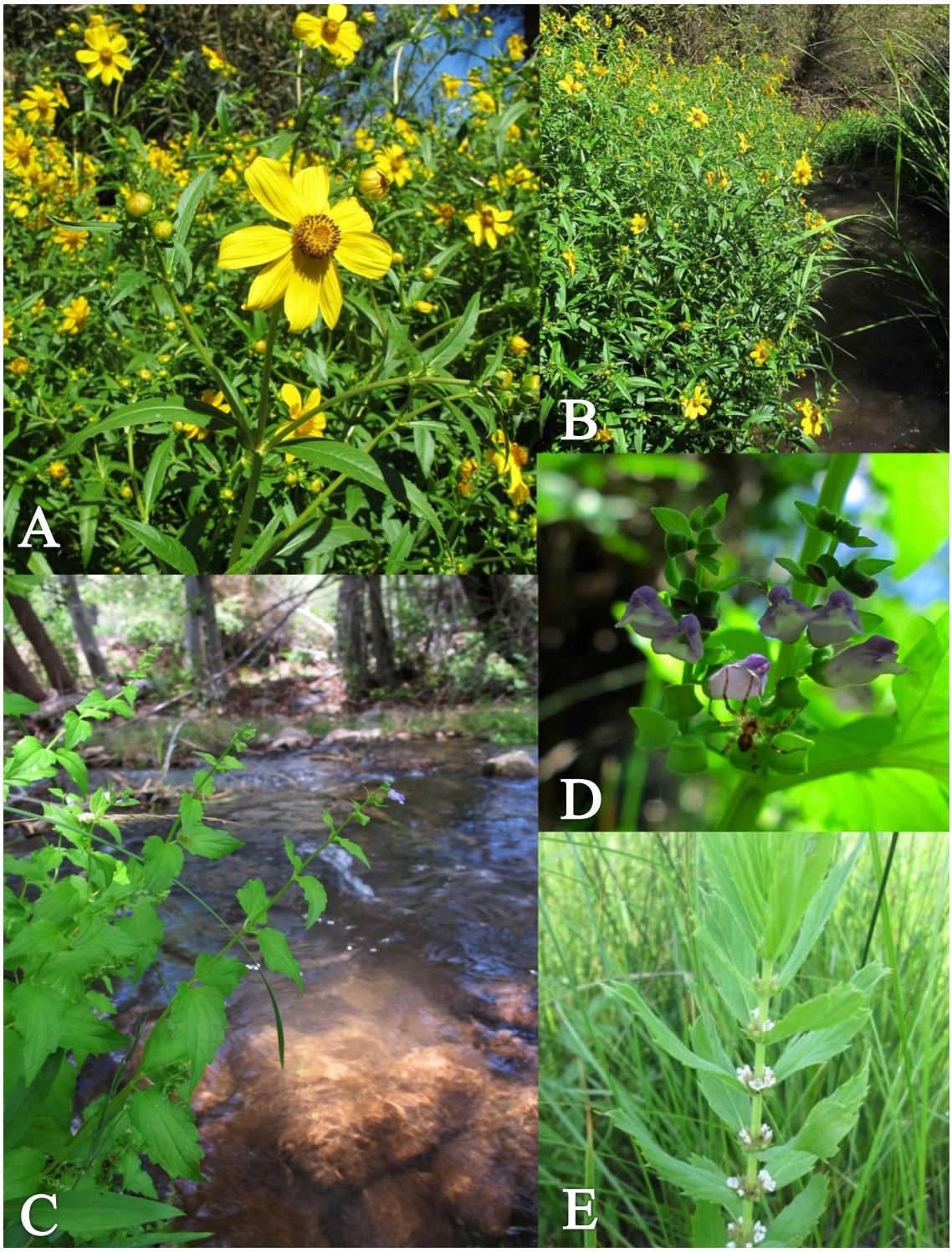

Figure 19. Wetland taxa rarely-collected in the Upper Verde region. A and B. Abundant streamside *Bidens laevis*. C and D. *Scutellaria lateriflora*.E. *Lycopus asper*.

Undercollected Upland Taxa

Physalis neomexicana (Solanaceae) – (Figure 20) restricted to the highlands of central Arizona and New Mexico, with less than 20 collections in Arizona. It was rarely collected in the region previously, never along the Upper Verde but was found at eight localities after above-average monsoons in 2012-2013 indicating high precipitation limits its abundance. It was found from the headwaters to Perkinsville in a variety of habitats and soil types from shady areas under pinyons, to the bases of rocky basalt cliffs and boulder talus, to sandy floodplains.

Escobaria missouriensis (Cactaceae) – (Figure 20) occurs from Texas north throughout the Great Plains to Canada, with S3 status in Arizona and S1 status in Utah (Natureserve 2015). It has been rarely collected in Arizona (13 collections) at widely scattered localities and the Upper Verde populations are over 161 km south of the nearest populations on the Arizona Strip. Over 10 new localities were found from the headwaters to Perkinsville on mesas, canyon rims and terraces in gravelly soils derived from dolostone and limestone.

Phacelia rupestris (Boraginaceae) – (Figure 20) uncommon throughout its range of New Mexico, Eagle Creek in eastern Arizona, and the Upper Verde River area. Along the Upper Verde it was recorded at seven localities, being frequent in Sullivan's Canyon and sparse downstream to Perkinsville, all restricted to shady north-facing rocky basalt outcrops, cliffs and talus. It has no conservation listing despite being infrequent in the state and habitat-specific.

Croton lindheimerianus (Euphorbiaceae) – (Figure 20) rare throughout its range of Texas, New Mexico and Arizona, its distribution in Arizona consists of two widely-

spaced centers with only six collections. I found a small population of ca. 30 plants near Bear Siding on an east-facing slope in calcareous soil. Together with nearby collections by Baker (*11986*) and Wright (*1251, 1633*), the Verde collections represent its northern limit. Despite its apparent rarity it does not have any State or Federal listing.

Figure 20. Undercollected upland taxa in the Upper Verde River region. A. *Physalis neomexicana*. B-C. *Croton lindheimerianus*. D. *Phacelia rupestris*.E, F, H.Various flowering forms of *Escobaria (Coryphantha) missouriensis*. G. *Escobaria (Coryphantha) missouriensis* in fruit.

Vegetation Communities

Several vegetation classifications have been developed for the southwestern United States and Arizona. These include the frequently-used Biotic Communities of the Southwest (Brown 1982) and the National Vegetation Standard (NVS), developed by multiple U.S. federal agencies, Non-Governmental organizations such as the Nature Conservancy, and the Ecological Society of America (ESA) (FGDC 2008). Recently the USGS National Gap Analysis Program (GAP) mapped vegetation using NVS categories over much of the Southwest with relatively high resolution via remote sensing, including the area along the Upper Verde (GAP 2011). Classification schemes developed over large areas are often general by nature and too coarse to accurately describe specific sites, making for local inaccuracies. I found this to be the case in the study area. My field data and observations indicate Brown and NVS categories are accurate and parallel in some areas, conflict in others, and are inaccurate in other areas.

I classify the vegetation using a combination of the two, by following a hierarchical system based on dominant physiogamy (e.g. woodland, shrubland, grassland) used by NVS, and lower-level categories using classification names from both Brown and NVS . Within the riparian zone I include five categories paralleling Stromberg (2008). In addition I describe three other distinct habitats in the area.

I WOODLANDS

Pinyon Juniper Woodland

Pinyon Juniper Woodland is the most abundant vegetation type in the Upper Verde River region and consists of often sparse, but sometimes dense (especially in

washes and steep slopes) stands of mixed or monotypic *Pinus edulis, Juniperus osteosperma* or *J. arizonica (J. coahuilensis)* (Figure 21). The understory varies in density with shrubs from 0.25 to 1.5 m in height with the following mixed or locally dominant taxa: *Acacia greggii*, *Berberis fremontii, B. haematocarpa, Cercocarpus montanus, Dalea Formosa, Forestiera pubescens, Parthenium incanum, Purshia stansburiana, Quercus turbinella, Rhus aromatica*, or *Mimosa biuncifera. Nolina microcarpa* and *Yucca baccata* are often present but more sparse. Common perennial herbs and subshrubs include *Artemisia ludoviciana, Eriogonum wrightii, Euphorbia fendleri, Gutierrezia sarothrae, Melampodium leucanthum*, and *Sphaeralcea parvifolia*. Common cacti include *Opuntia phaeacantha, O. engelmannii*, and *Cylindropuntia whipplei.*

Perennial bunchgrasses range from sparse to dense in the understory, Various subspecies of *Aristida purpurea, Bouteloua curtipendula, B. eriopoda* and *B. gracilis co-occur* with patches of *Elymus elymoides, Hesperostipa neomexicana, Koeleria pyramidata, Poa fendleriana, Sporobolus cryptrandrus*, and others.

Pinyon Juniper Woodlands dominate the landscape from the upper study reach (elev. 1350 m) to the Verde Valley (elev. 1100 m) on hillsides, in canyons, along rims, and mesas in limestone, sandstone and basalt-derived substrates. On basalt mesas from the headwaters to Perkinsville, monotypic stands of similar-aged juniper dominate the landscape, presumed to having encroached on historic Plains Grasslands.

Figure 21. Examples of Pinyon Juniper Woodland: A. Expanse of woodlands near Bull Basin dominated by *Juniperus osteosperma* with scattered *Pinus edulis*.B. On limestone slopes near Perkinsville with *Pinus edulis* trees and *Cercocarpus montanus* and *Glossopetelon spinescens* shrubs in the foreground blending with Chihuahuan-Apacherian Desert Scrub evidenced by the grayish-green shrub *Parthenium incanum* covering slopes in the background.

Pinyon Juniper woodlands routinely integrade with the other vegetation types and here corresponds with NVS Colorado Plateau Pinyon-Juniper and Madrean Pinyon-Juniper Woodlands and is representative of Brown's Great Basin Conifer Woodland.

II SHRUBLANDS

Apacherian-Chihuahuan Scrub

Apacherian-Chihuahuan Scrub is the second-most abundant community along the Upper Verde, consisting of mostly medium-sized (0.25-1 m), sparse-to-dense stands of common Chihuahuan Desert shrubs such as *Parthenium incanum, Dalea formosa,* and *Aloysia wrightii* (Figure 22A and B). Additional shrubs can be dominant or codominant such as *Acacia greggii, Ephedra viridis, Glossopetelon spinescens, Mimosa biuncifera, Nolina microcarpa, Prosopis velutina, Purshia stansburiana, Yucca baccata,*and *Ziziphus obtusifolia*. Other components include subshrubs and perennial herbs such as *Abutilon parvulum, Acourtia wrightii, Allionia incarnata, Astragalus calycosus* var.*scaposus, Artemisia ludoviciana, Chaetopappa ericoides, Melampodium leucanthum, Menodora scabra, Polygala alba, Thamnosma* Texana, and *Thymophylla acerosa*. Dominant grasses include *Bouteloua curtipendula, B. eriopoda, Erioneuron pilosum, Muhlenbergia porteri, Tridens muticus, Sporobolus cryptandrus, Bothriochloa barbinodis,* and *Dasyochloa pulchella*. Common cacti include *Opuntia engelmannii, O. phaeacantha,* and *Coryphantha vivipara*.

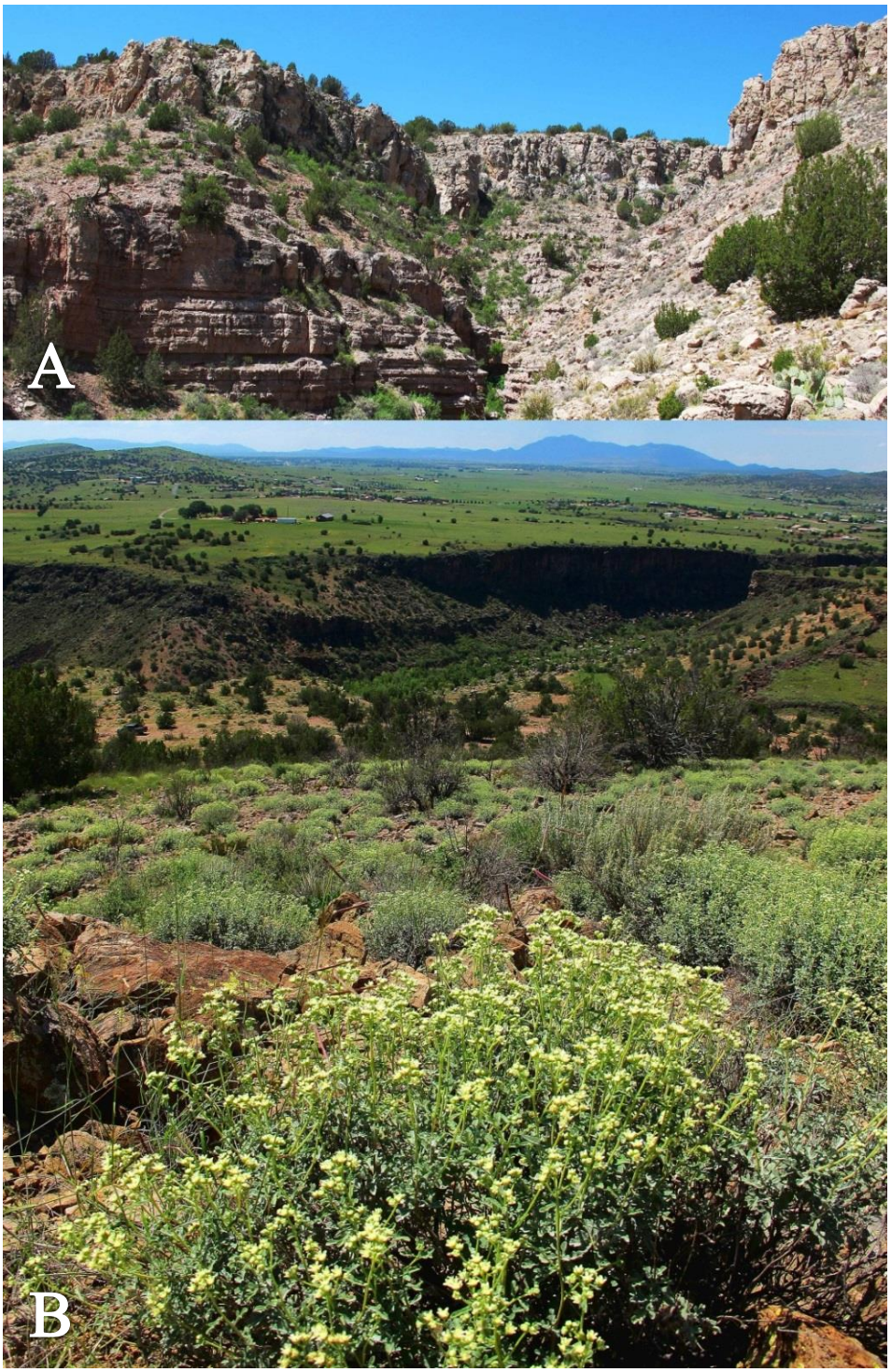

Figure 22. Examples of Chihuahuan-Apacherian Scrub: A. On steep, rocky dolostone slopes near Paulden and the headwaters where south and north-facing slopes have varying densities of *Parthenium incanum*, *Dalea formosa*, *Ephedra viridis*, *Purshia stansburiana*, and *Juniperus osteosperma*. B. On limestone slopes near the headwaters dominated by *Parthenium incanum* with expanses of Plains Grassland covering the Chino Valley in the background.

These scrublands often dominate steep slopes in canyons, on hillsides, and rims in limestone and sandstone-derived gravelly, rocky soils from the lower end of the study area in the Verde Valley (elev. 1000 m) to the headwaters (elev. 1350 m). They form a patchy mosaic with Pinyon Juniper Woodland, mostly replacing it on steep slopes.

Apacherian-Chihuahuan Scrub coincides well with NVS "Apacherian-Chihuahuan Mesquite Upland Scrub" and with Brown's "Chihuahuan Desert Scrub" although Brown did not map this type for the area.

Sonoran Scrub

Sonoran Scrub is represented by moderately-dense to dense growth of shrubs in a few distinct types: 1) a *Canotia holacantha*-dominates on slopes and rims from Perkinsville downstream to Clarkdale with shrubs 1-3 m tall (Figure 23B), 2) *Fouquieria splendens* (to 4 m tall) -*Larrea tridentata* (1-2 m tall) communities dominate from Mormon Pocket downstream to the Verde Valley (Figure 23A), and 3) mixed scrub dominated by often dense, 0.5-2 m tall *Acacia greggii, Mimosa biuncifera, Prosopis velutina,* and *Ziziphus obtusifolia* from Perkinsville to the Verde Valley.

Juniperus spp. are frequent yet sparse. Other large shrubs include *Berberis haematocarpa* and *Lycium andersonii*, and the understory is composed of any mix of shrubs especially as *Tiquilia canescens* and *Krameria erecta;* and Chihuahuan/ Apacherian Scrub species such as *Parthenium incanum, Dalea formosa,* and *Aloysia wrightii*. Subshrubs and perennial herbs such as *Acourtia wrightii, Allionia incarnata,*and *Melampodium leucanthum* are frequent*;* cacti are common, primarily *Opuntia engelmannii* and *O. phaeacantha*; and grasses include subspecies of *Aristida purpurea,*

Bouteloua curtipendula, *B. eriopoda*, *Erioneuron pilosum*, *Hilaria berlangeri*, *H. mutica*, *Muhlenbergia porteri*, *Tridens muticus* and *Sporobolus cryptandrus.*

On south-facing slopes, especially along the Black Canyon of the Verde Valley, species more common in the Sonoran Desert become frequent such as *Cottsia gracilis*, *Dichelostemma capitatum*, and *Krameria erecta* and annuals abound in the spring, including *Cryptantha* and *Phacelia* spp.

Sonoran Scrub associations occur throughout the Verde Valley north to Perkinsville, especially on steep slopes, rims and mesas in limestone and sandstone-derived, often gravelly, rocky soils. As slopes become more gradual, grasses increase as scrub intergrades with Semi-desert Grasslands. On many north-facing slopes and higher elevations they intergrade with Interior Chaparral or Pinyon Juniper Woodland.

The Sonoran Scrub characterized here includes what NVS characterized "Sonoran Mid-Elevation Desert Scrub" and "Sonora-Mojave Creosotebush-White Bursage Desert Scrub"; and coincides with Brown's "Cresotebush-Crucifixion-thorn Series" of Sonoran Desert Scrub.

Figure 23. Examples of Sonoran Scrub: A. At Mormon Pocket with slopes of *Canotia holacantha*, *Acacia greggii*, *Prosopis velutina*, *Parthenium incanum*, and *Mimosa biuncifera*. B. Near the Verde River-Sycamore Canyon confluence with south-slopes dominated by *Fouquieria splendens*, *Acacia greggii*, *Mimosa biuncifera*, *Opuntia engelmannii*, and low-growing *Parthenium incanum.*

Interior Chaparral

Interior Chaparral (Figure 24) is characterized by moderate to dense growth of mixed or monotypic stands of *Quercus turbinella, Cercocarpus montanus* or *Mimosa biuncifera* ranging in height from 1-3 m. Other shrub indicators of this type include *Ceanothus greggii, Fendlera rupicola* and *Fraxinus anomala* ssp. *lowellii*. *Pinus edulis* and *Juniperus* spp. are frequent and other associated shrubs include *Berberis haematocarpa, Celtis reticulata, Ephedra viridis, Forestiera pubescens, Nolina microcarpa, Purshia stansburiana, Ptelea trifoliata, Rhamnus ilicifolia, Rhus aromatica, Yucca baccata,* and *Ziziphus obtusifolia.*

The understory of Interior Chaparral is often sparse except where the canopy opens and consists of perennial herbs and subshrubs such as *Artemisia ludoviciana, Boechera perennans, Brickellia californica,* and *Eriogonum wrightii*. Grasses include subspecies of *Aristida purpurea, Bouteloua curtipendula, Muhlenbergia emersleyi* and species typical of shady slopes such as *Poa fendleriana* and *Koeleria pyramidata.* Chaparral communities are occasional along the Upper Verde from near the headwaters to the Sycamore Canyon confluence. They are mostly limited to steep, north and east-facing slopes in washes and canyons on limestone, sandstone and igneous-derived substrates. On gentler, south-facing slopes, in course igneous soils such as near Rio Verde Ranch, shrub cover is typically more sparse. (Figure 24A).

Chaparral in the study area coincides with NVS “Mogollon Chaparral” and “Sonora-Mojave Semi-Desert Chaparral”, and Brown’s “Interior Chaparral”.

Figure 24. Examples of Interior Chaparral. A. Thick *Quercus turbinella* becoming trees with *Forestiera pubescens* and *Ephedra viridis*; interacting with Riparian Woodlands represented by *Vitis arizonica,* and *Fraxinus velutina*.B. Near Rio Verde Ranch where *Quercus turbinella* is sparse-to-thick on coarse igneous soils with *Cercocarpus montanus, Juniperus monosperma,* and *Pinus edulis*.

III GRASSLANDS

Plains Grassland

Plains Grassland is dominated by perennial and annual grasses and forbs of small stature (to ca. 0.5 m) with infrequent shrubs and trees (Figure 25). Common perennial grasses include subspecies of *Aristida purpurea, A. ternipes* var. *ternipes, Bouteloua curtipendula, B. gracilis, B. eriopoda, Hilaria mutica, Hopia obtusa,* and *Tridens muticus*. Occurring less frequently are *Bothriochloa barbinodis, Leptochloa dubia,* and *Muhlenbergia torreyi.* Annual grasses abound post-monsoon, most commonly *Aristida adscensionis, Chloris virgata, Leptochloa panicea,* and *Panicum hirticaule.*

Trees and shrubs may cluster around rocky outcrops and include *Artemisia ludoviciana, Atriplex canescens, Berberis fremontii, Eriogonum wrightii, Forestieria pubescens, Gutierrezia sarothrae, Juniperus osteosperma, J. monosperma, Krascheninnikovia lanata,* and *Purshia stansburiana.* Cacti such as *Cylindropuntia whipplei*, *Opuntia engelmannii,* and *O. phaeacantha* are sparse to locally abundant. During monsoon season, flowering herbs become dense, especially in catchements or swales. Common species include *Allionia incarnata*, *Amaranthus* spp., *Chenopodium* spp., *Eriogonum palmerianum*, *Portulaca oleracea*, *Heliomeris longifolia*, *Ipomoea costellata, Kallstroemia parviflora*, *Pectis prostrata,* and *Sanvitalia abertii*.

Plains Grassland occurs in the study area from the headwaters (elev. 1350 m) to Perkinsville (elev. 1200 m) on rolling hills and flat basalt mesas where it was mapped as "Plains Grassland" by Brown and as "Plains Short-grass Prairie" by Brown and Makings (2014). GAP analysis did not map Plains Grassland in the area.

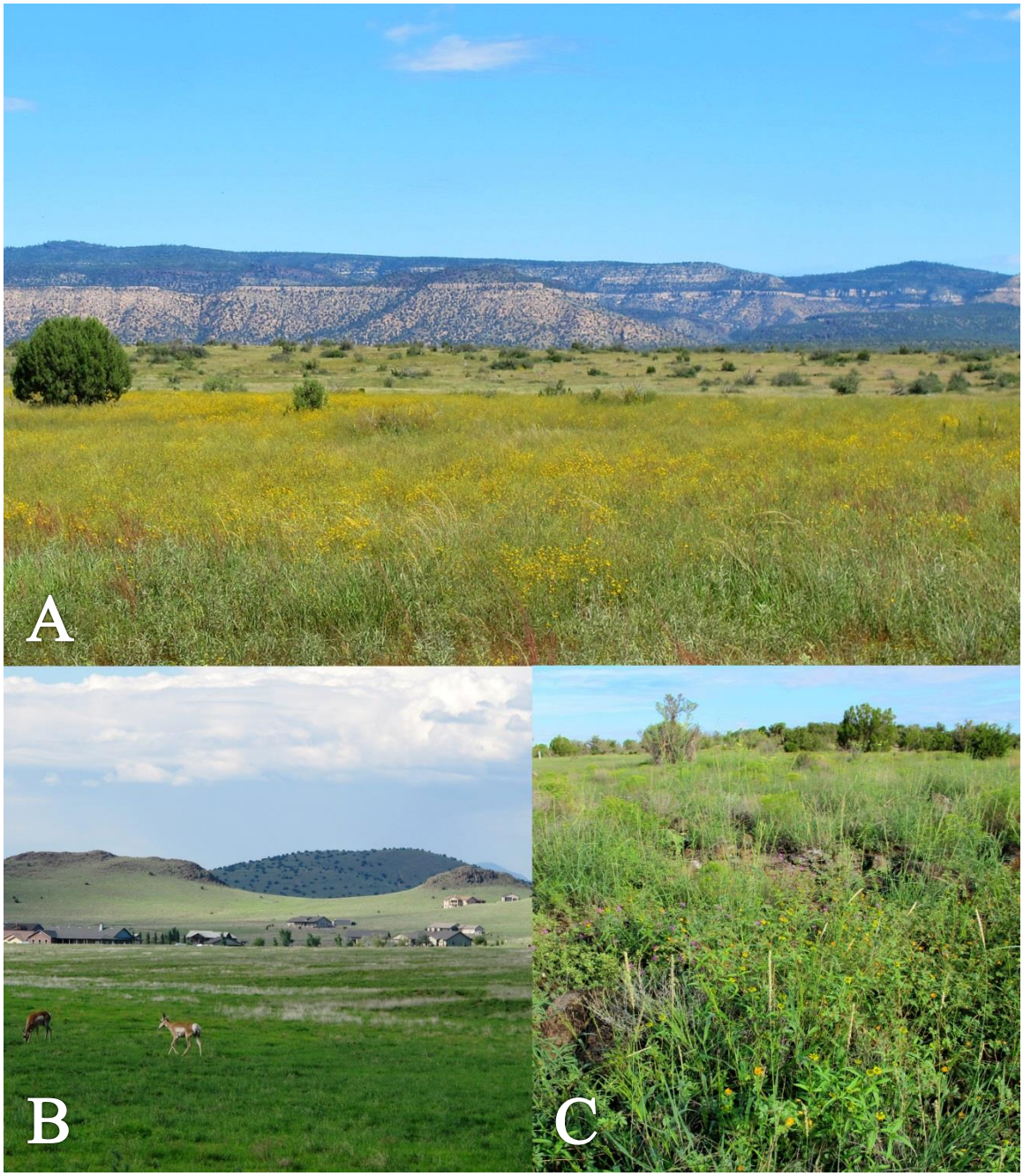

Figure 25. Examples of Plains Grassland: A. Near Perkinsville on a basalt mesa with *Bouteloua curtipendula*, *Sporobolus cryptandrus*, *Solanum elaeagnifolium*, mixed with yellow-flowered *Heliomeris longifolia*. B. Expansive grasslands of the Chino Valley surrounding the headwaters of the Verde River. C. Monsoon phase along basalt rims near the headwaters with dense growth of *Allionia incarnata*, *Bouteloua curtipendula*, *Hilaria mutica*, *Ipomoea costellat*a, *Kallstroemia parviflora*, *Panicum hirticaule*, *Portulaca oleracea*, and *Sanvitalia abertii.*

Semi-Desert Grassland

This grassland (Figure 26) is dominated by perennial and annual grasses of small stature (to ca. 0.5 m) with sparse, usually thorny shrubs. Common grasses include subspecies of *Aristida purpurea, Bouteloua curtipendula, B. eriopoda, Eragrostis intermedia, Hilaria belangeri, H. mutica, Muhlenbergia porteri, Scleropogon brevifolius,* and *Sporobolus cryptandrus,* while *Dasyochloa pulchella* colonizes sparsely-vegetated areas. The common shrubs are *Acacia greggii*, *Krameria erecta, Mimosa biuncifera,* and *Prosopis velutina*. Shrubs such as *Fouquieria splendens, Larrea tridentata* and the acaulescent to arborescent *Yucca elata* var. *verdiensis* occur sparsely as these grasslands intergrade with Sonoran Scrub. Other components include cacti such as *Echinocereus fasciculatus, Opuntia engelmanni* and *O. phaeacantha*; forbs such as *Allionia incarnata, Dichelostemma capitatum, Kallstroemia parviflora, Melampodium leucanthum,* and *Physaria cinerea*; and annual grasses such as *Panicum hirticaule* and *Aristida adscensionis.*

Semi-desert Grassland only occurs in the Verde Valley and covers rolling hillsides, valleys and flats along rims on substrates derived from basalt, limestone and alluvial deposits. This type coincides with NVS "Apacherian-Chihuahuan Semi-Desert Grassland" and Brown's Semi-desert Grassland.

Figure 26. Semi-Desert Grasslands surrounding the Black Canyon of the Verde River in the Verde Valley near Clarkdale. *Bouteloua curtipendula, Aristida purpurea, Dasyochloa pulchella,* and *Aristida adscensionis* are common. Reddish mounds of *Muhlenbergia porteri* can be seen with patches of white *Melampodium leucanthum* and the scattered dark green shrubs are *Acacia greggii*, *Mimosa biuncifera,* and *Prosopis velutina*.

IV WETLANDS AND RIPARIAN AREAS

Wetland and riparian communities are the dominant vegetation in valley bottoms characterized by disturbance-tolerant taxa whose physiogamy and composition varies based on water availability and fluvial disturbance regimes (Figure 27). NVS has several classifications for these zones and Brown named them Riparin Deciduous Forests. Stromberg (2008) categorized Upper and Middle Verde riparian vegetation into seven types reflecting water availability, flood disturbance, and edaphic factors. Here I utilize five categories paralleling Stromberg in order of sensitivity to streamflow decline.

Marshes and Streamside Wetlands

Marshes and Streamside Wetlands occur in the wettest portions of the riparian zone where surface soils are saturated year-round and are dominated by dense herbaceous vegetation to ~2 m tall (Figure 28). These include flood-disturbed banks, channel bars, and areas with standing water such as depressions in secondary channels and abandoned meanders. Ubiquitous taxa include *Equisetum* spp., *Juncus articulatus, Schoenoplectus americanus,* and *Typha domingensis.*Other common taxa include *Aster subulata, Berula erecta*, *Cyperus odoratus*, *Eleocharis palustris, E. macrostachya, Hydrocotyle verticillata, Nasturtium officinale*, *Persicaria lapathifolia*, and *Pseudognaphalium luteoalbum*. Species that may become locally abundant include *Ambrosia psilostachya, Bidens laevis, Carex senta, Cynodon dactylon, Echinochloa crus-galli, Erythranthe guttata, Equisetum arvensis, E. laevigatum, Festuca arundinacea*, *Juncus balticus, J. mexicanus, J. torreyi, Leersia oryzoides, Medicago* spp, *Mentha spicata, Paspalum dilatatum, P. distichum, Poa pratensis, Plantago major, Polypogon monspeliensis, P. viridis, Rumex crispus, Schoenoplectus acutus, S. pungens, Trifolium repens* and *Xanthium strumarium.* The overstory can be absent or dense and composed of Riparian Forests and Shrubland species. Numerous riparian tree species colonize these zones persisting as saplings and 1-3 m tall *Baccharis salicifolia* are common.

Marshes and Streamside Wetlands occur along the entire study reach and correspond to the NVS “North American Arid West Emergent Marsh”, Brown’s “Sonoran Interior Marshland”, and a combination of Stromberg’s “Marshlands”, “Wet Meadows”, and “Disturbed Wetlands”.

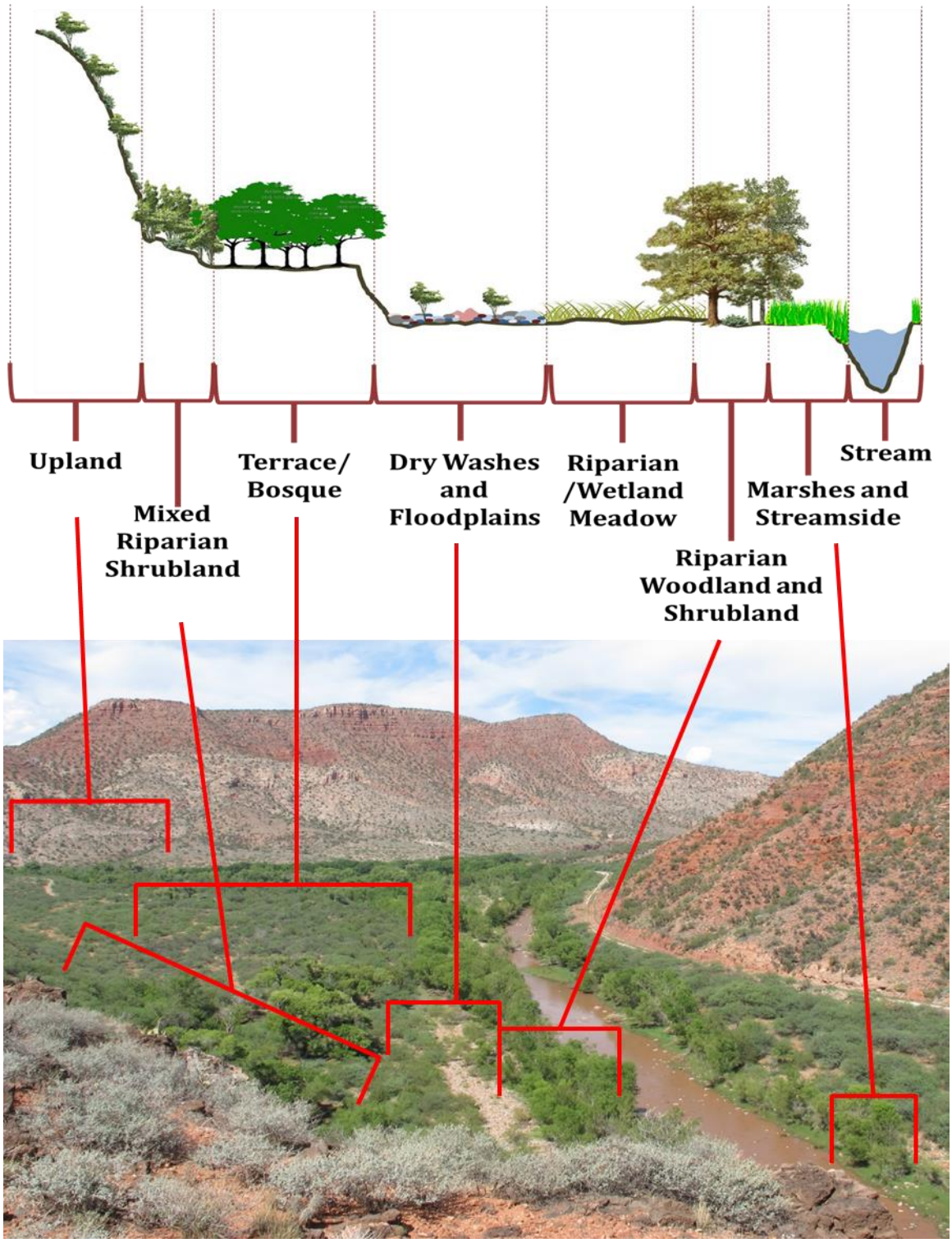

Figure 27. Simplified schematic and photo showing an example of lateral locations of riparian plant communities.

Figure 28. Marshes and Streamside Wetlands. A. With abundant *Typha domingensis*, *Schoenoplectus americanus* with *Salix* and *Fraxinus velutina* saplings downstream from Duff Spring. B. Near Bear Siding with *Typha domingensis* surrounding a pool and a dense marsh of *Equisetum arvensis*, *E. laevigata* and grasses, sedges and rushes such as *Juncus articulatus*, *Hordeum jubatum*, *Juncus mexicanus* and others. C. Dense stands of *Schoenoplectus americanus* line the banks in many areas, such as near Perkinsville.

Riparian Woodland and Shrubland

Riparian Woodland and Shrublands (Figure 29) are mixes of mostly deciduous trees and shrubs occuring on streambanks, floodplains and higher terraces receiving floods, and with high water tables. There are three main phases: dense mixed forests of early-successional shrubs to small trees 3-5 m tall on frequently-flooded streambanks and floodplains (Figure 29A); larger trees in less-frequently flooded areas forming shady, mesic environments with herbaceous understory (Figure 29 C); and higher terraces with larger trees forming widely-spaced forests with canopies to over 20 m in height (Figure 29B). These forests require flooding to establish and high water tables to persist. Extensive recruitments occur after large-scale scouring events (Lite and Stromberg 2005).

The ubiquitous tree species—*Populus fremontii*, *Salix goodingii*, and *Fraxinus velutina*—vary in dominance, and *Alnus oblongifolia* and *Platanus wrightii* co-dominate from Mormon Pocket downstream through the Verde Valley. Tracts of forest composed of large *Populus fremontii* to 25 m tall and over 160 years old occur on higher terraces in wider alluvial valleys such as at Perkinsville (Figure 29B) (Personal observation, Vanessa Beauchamp unpublished data).

Other common components Riparian Woodlands and Shrublands include various associations of trees: *Acer negundo, Celtis reticulata, Juglans major, Juniperus osteosperma, Salix laevigata*; shrubs to small trees such as *Acacia greggii, Baccharis salicifolia, Mimosa biuncifera, Prosopis velutina*, *Salix exigua* and *Tamarix ramosissima*; and subshrubs such as *Brickellia californica* and *B. floribunda*. Vines cover the ground or climb vegetation including *Funastrum cynanchoides, Parthenocissus vitacea,*

Toxicodendron radicans, and *Vitis arizonica*. Common herbs occurring throughout these woodlands include disturbance-adapted species like *Amaranthus palmeri, Ambrosia psilostachya, Boerhavia coccinea, Datura wrightii, Eriogonum polycladon, Equisetum* spp., *Euphorbia* spp., *Heterotheca subaxillaris, Melilotus officinalis, Rumex crispus*, and *Xanthium strumarium.* Graminoids can be isolated or in dense stands intergrading with Riparian Meadows and include *Elymus canadensis, E. glaucus, Bothriochloa barbinodis, B. laguroides, Bromus diandrus, B. tectorum, B. japonicus, B. marginatus, Carex praegracilis, Cynodon dactylon, Echinochloa crus-galli, Festuca arundinacea, Juncus mexicanus, J. balticus*, and *Poa pratensis*.

Riparian Woodland and Shrublands occur along the entire study reach yet stands of this type were historically less frequent, most having established post-1993 in response flood events that caused scouring, channel incision and narrowing (Neary et al 2012) (see discussion in the Site Description section). This type was mapped by GAP as "North American Warm Desert Riparian Woodland and Shrubland" and **"**North American Warm Desert Lower Montane Riparian Woodland and Shrubland". They represent Brown's "Interior Deciduous Riparian Woodland", what has been regionally described as "Cottonwood-Willow Riparian Gallery Forest" and Stromberg's "Hydromesic Pioneer Forests" with components of "Mesoxeric Pioneer Woodlands".

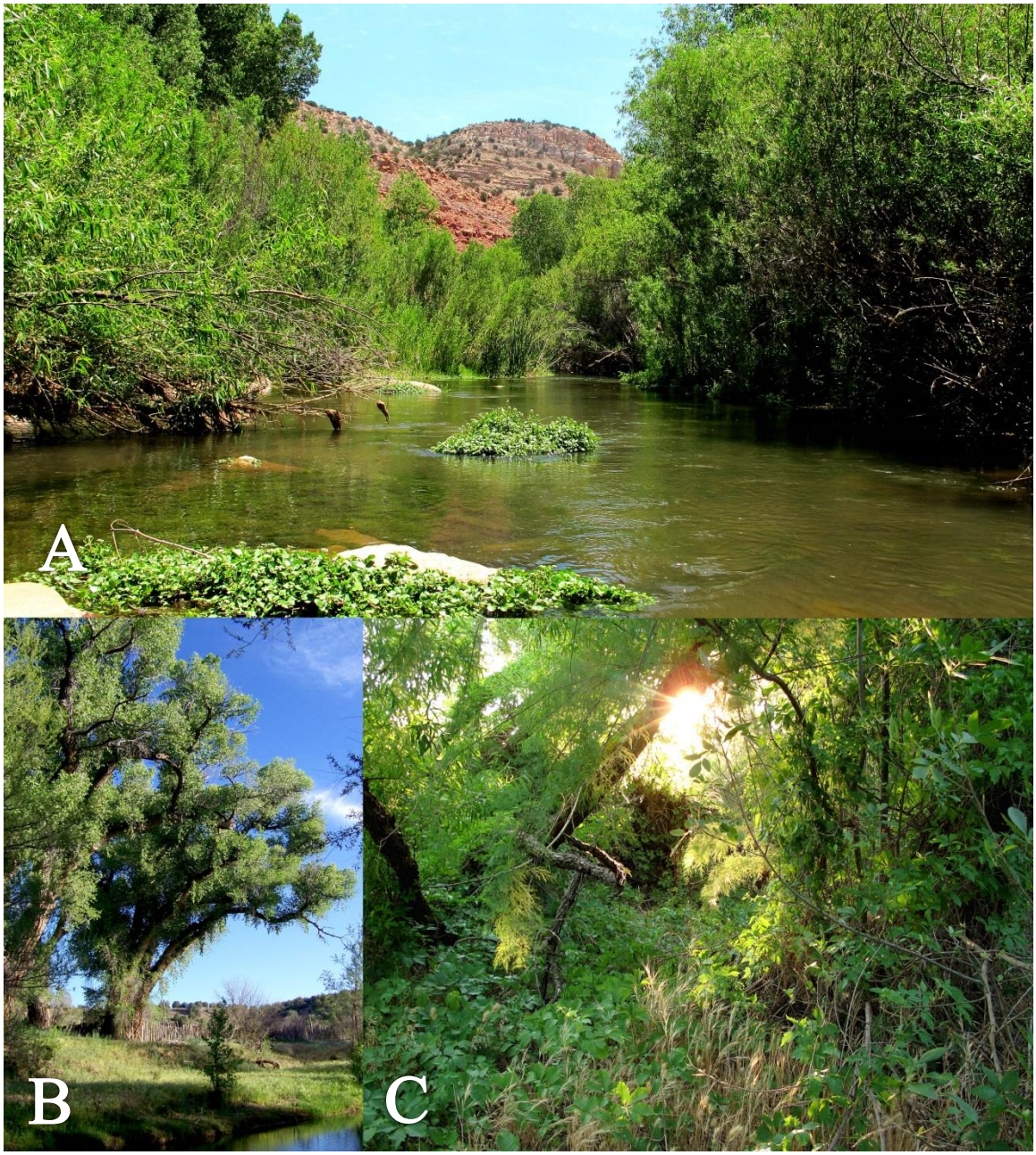

Figure 29. Examples of Riparian Woodland and Shrubland. A.Dense brushy growth along the stream and floodplain near Perkinsville with mostly ca. 25 year-old stands of *Fraxinus velutina, Populus fremontii*, *Salix goodingii*, and *Baccharis salicifolia*. B. Large *Populus fremontii* in older forest on high terraces at Perkinsville. C. Lush undergrowth near Clarkdale with *Fraxinus velutina* and *Salix gooddingii,* a dense covering of the vine *Parthenocissus vitacea*, and annual *Bromus diandrus* forming much of the groundcover.

Riparian Meadows

Riparian Meadows are composed of dense stands of sedges, rushes and grasses and sparse cover of shrubs or trees (Figure 30). They can occur away from the stream in drier, silty soils where the most common species are *Carex praegracilis*, *Juncus balticus* and *J. mexicanus*, or in other areas dense turf-forming *Cynodon dactylon* . All of these species are borne of thick, hardy rhizomes and form dense stands which buffer them from flood scouring while stabilizing soils (Figure 30A). Or Riparian Meadows occur in moister soils nearer to the stream or in springs (Figure 30B) where they intergrade with Marshes and Streamside Wetlands with species such as *Agrostis stolonifera, Poa pratensis, Polypogon monspeliensis, P. viridis, Schoenoplectus americanus*, and *Juncus articulatus.*

Both wet and dryer conditions host pure to mixed stands of large robust bunch or turf-forming grasses including *Cynodon dactylon*, *Elymus glaucus*, *Festuca arundinacea*, or *Sporobolus airoides*. Forbs such as *Anemopsis californica*, *Lotus corniculatus*, *Medicago* spp., and *Trifolium* spp. are also frequent. Riparian Meadows also intergrade with Mesquite Terraces and shrub habitats on higher terraces sometimes in open areas consisting of small remnant patches of *Distichilis spicata*, *Muhlenbergia asperifolia*, and *Sporobolus airoides*. Riparian Meadows were more prevalent on these terraces pre-1993 but events such as damming, catastrophic floodevents, and resulting channel incision, combined with land-use practices has reuced their extent (Neary et al. 2012).

Figure 30. Examples of Riparian Meadows. A. Near Duff Spring in dryer soils dense with bunchgrasses such as *Festuca arundinacea*, and rhizomotous sedges and rushes such as *Carex praegracilis* and *Juncus mexicanus*. B. Hillslope spring near the Verde-Sycamore Canyon confluence where saturated soils support dense stands of *Agrostis stolonifera, Equisetum arvense, Leymus triticoides, Juncus xiphioides,* and *Polypogon viridis.* C. Streamside terrace near Sycamore Canyon with *Anemopsis californica* under the shade of *Salix goodingii* with dense growth of turf-like *Cynodon dactylon* and various forbs in sunny areas.

Riparian Meadows exist downstream of Rio Verde Ranch, upstream and downstream of Duff Spring, downstream from Cambell's Ranch, and upstream of Bear Siding. They coincide with the NVS association "Chihuahuan-Sonoran Desert Bottomland", "Swale Grassland", Brown's "North American Arid West Emergent Marsh" and "Sonoran Interior Marshland", and Stromberg's "Riparian Grasslands".

Dry Washes and Floodplains

Dry Washes and Floodplains (Figure 31) are characterized by being seasonally flooded, often sparsely vegetated areas with sandy, gravelly substrates and high amounts of cobble. Floodplain vegetation (Figure 31A, B and D) consists of sparse to semi-dense 1-3 m tall shrubs, the most important being *Acacia greggii, Chilopsis linearis, Mimosa biuncifera,* and *Prosopis velutina*. Tree species of Riparian Forest and Shrubland surround floodplains and their saplings and shrubs are common, especially in low-lying areas. Common subshrubs and forbs include the ubiquitous *Brickellia floribunda* and species such as *Ambrosia psilostachya, Gutierrezia sarothrae, Phaseolus angustissimus, Senecio flaccidus,* and *Solidago wrightii.* Other shrubs include *Amorpha fruticosa, Baccharis salicifolia, B. sarothroides, Fallugia paradoxa, Quercus turbinella,* and *Tamarix ramosissima.*

The structure and composition of washes (Figure 31 C and E) parallels floodplains but vegetation is mostly restricted to the banks and can become brushy. Common wash shrubs include *Berberis fremontii, B. haematocarpa, Fallugia paradoxa, Forestiera pubescens, Purshia stansburiana,* and *Quercus turbinella.*

Upland species routinely colonize Dry Washes and Floodplains, intergrading with riparian taxa and increasing local diversity. Some examples of forbs include dense, tangled growths of *Boerhavia coccinea*, *Amaranthus* spp., *Chenopodium* spp., *Cryptantha* spp., *Euphorbia* spp., *Eriogonum palmeranium, E. polycladon, Gilia* spp., *Hymenothrix loomisii, Ipomopsis* spp., *Lupinus* spp., and *Polanisia dodecandra* among many others. Grasses are common and include perennials such as *Bothriochloa barbinodis, B. laguroides* subsp. *torreyana, Bouteloua curtipendula,Sporobolus cryptandrus* and *S. contractus*; and sometimes dense annuals after monsoons in sandy areas*: Bouteloua barbata, B. aristoides, Bromus* spp., *Eragrostis cilianensis*, and *E. pectinacea*.

Dry Washes and Floodplains are common throughout the study stretch and correspond to NVS "North American Warm Desert Wash" yet do not have an analog in Brown's classification. Stromberg classified these habitats under "Xeroriparian Shrublands" and "Mesoxeric Pioneer Woodlands".

Bosques and Mixed Riparian Shrubland

Bosques and Mixed Riparian Shrublands (Figure 32) are forests and shrublands of smaller stature (2-8 m) occuring on higher terraces and slopes on the margins of the riparian corridor. Mesquite bosques are typically on flat terraces with various densities of mature *Prosopis velutina* 3-5 m tall.

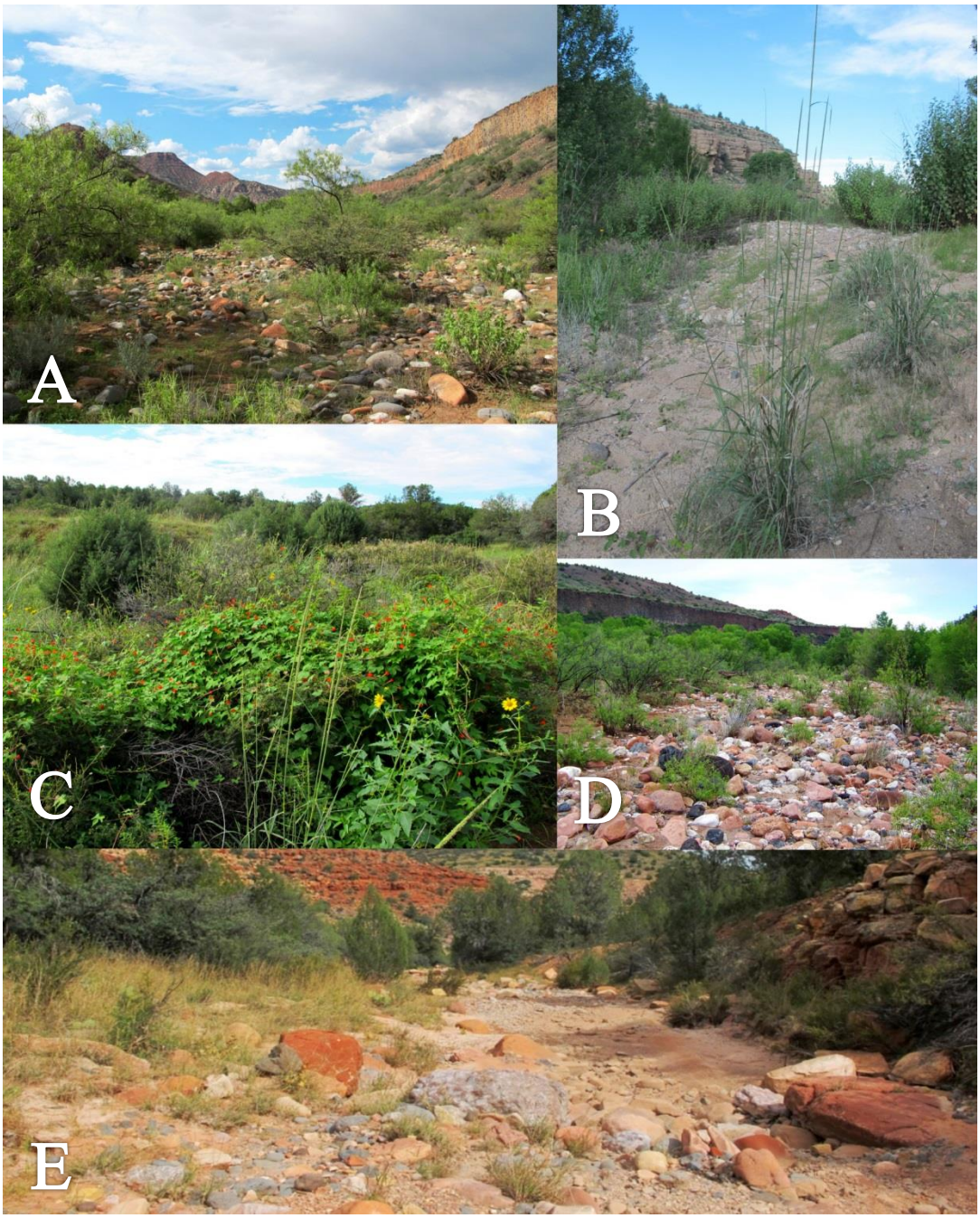

Figure 31. Dry Washes and Floodplains. A. Cobbly floodplain near Sycamore Canyon confluence with *Chilopsis linearis, Acacia greggii, Brickellia floribunda* and *Prosopis velutina.*B. Sandy floodplains are common, here with the frequent *Sporobolus contractus*. C. Sandy wash after abundant monsoons with *Fallugia paradoxa* covered in *Ipomoea cristulata*. D. Open cobbly floodplains are ubiquitous, here in the Black Canyon of the Verde Valley with *Chilopsis linear*is, *Brickelia floribunda, Prosopis velutina* and trees such as *Fraxinus velutina* and *Platanus wrightii*. E. Wash near Bear Siding where *Juniperus, Pinus edulis, Fallugia paradoxa* and *Quercus turbinella* line the sides.

Other terraces can be occupied by open, well-developed forests of *Celtis reticulata, Sapindus saponaria,* or *Juglans major*. Many terraces were heavily grazed in the past leaving an understory of plants either disturbance-adapted or avoided by cattle. These can include sparse to dense stands of *Hordeum* and *Bromus* spp., with herbs such as *Amaranthus* spp., *Chorispora tenella, Lactuca serriola*, *Lycium pallidum, Salsola tragus,* and *Solanum elaeagnifolium.*

Bosques and Mixed Riparian Shrublands often intergrade with floodplains where they are composed of dense stands of smaller-stature (<3 m tall) *Acacia greggii* and *Mimosa biuncifera*. In all of these habitats various trees and shrubs commonly inter-mingling are *Ziziphus obtusifolia, Juniperus osteosperma, Lycium pallidum, Berberis haematocarpa,* and *B. fremontii*.

Along the margins of the riparian corridor on slopes and terraces, and leading to the uplands are the Mixed Riparian Shrublands. These often-mesic habitats intergrade with riparian woodlands resulting in co-occurrence of upland and riparian species, forming some of the most diverse communities along the Upper Verde. The following are often present in mixed stands: *Acacia greggii, Berberis haematocarpa, B. fremontii, Celtis reticulata, Forestiera pubescens, Fraxinus velutina, Mimosa biuncifera, Quercus turbinella, Rhus aromatica, Juglans major, Juniperus osteosperma, Sapindus saponaria,* and *Ziziphus obtusifolia.* Other less-frequent, yet consistent members include *Acer negundo, Frangula californica, Garrya wrightii, Morus microphylla, Ptelea trifoliata, Rhamnus ilicifolia*, *Ribes aureum,* and *R. cereum.*

Vines are common, especially *Funastrum cynanchoides, Toxicodendron radicans,* and *Vitis arizonica*. The understory contains grasses such as *Bouteloua curtipendula, Bromus rubens, B. diandrus, B. tectorum, Elymus glaucus, Koeleria pyramidata, Leymus triticoides, Pascopyrum smithii*, and *Poa fendleriana*; and herbs such as *Apocynum cannibinum, Chorispora tenella, Claytonia perfoliata, Galium aparine, Lamium amplexicaule, Parietaria hespera, Penstemon psuedospectabilis* and various annual mustards.

Bosques and Mixed Riparian Shrublands occur along the entire corridor from the lowest to highest elevations though their composition varies longitudinally. They correspond to the NVS "North American Warm Desert Riparian Mesquite","Apacherian-Chihuahuan Mesquite Upland Scrub", and "Sonoran Mid-Elevation Scrub"; Brown's "Riparian Scrublands" and components of "Sonoran Riparian Deciduous Woodland"; and Stromberg's "Successional Forests and Shrublands".

V OTHER DISTINCT VEGETATION TYPES

Cliffs and Outcrops

Cliffs and Outcrops (Figure 33) occur as sheer cliffs to sloping rock 2 to over 100 m tall in a variety of geologic formations especially Martin Formation Dolostone, Redwall and Supai Limestone, and basalt. Plants in these habitats often grow from cracks and catchments of soil in rock depressions and on ledges. Common indicator species from surrounding communities will often cling to cliffs and become twisted and gnarled such as *Pinus edulis, Purshia stansburiana,* and *Juniperus* spp. Characteristic species of Cliffs and Outcrops are often rare in the region and restricted to rocky habitats. These include *Chamaebatiaria millefolium, Cheilanthes feei, Petrophyton caespitosum, Perityle*

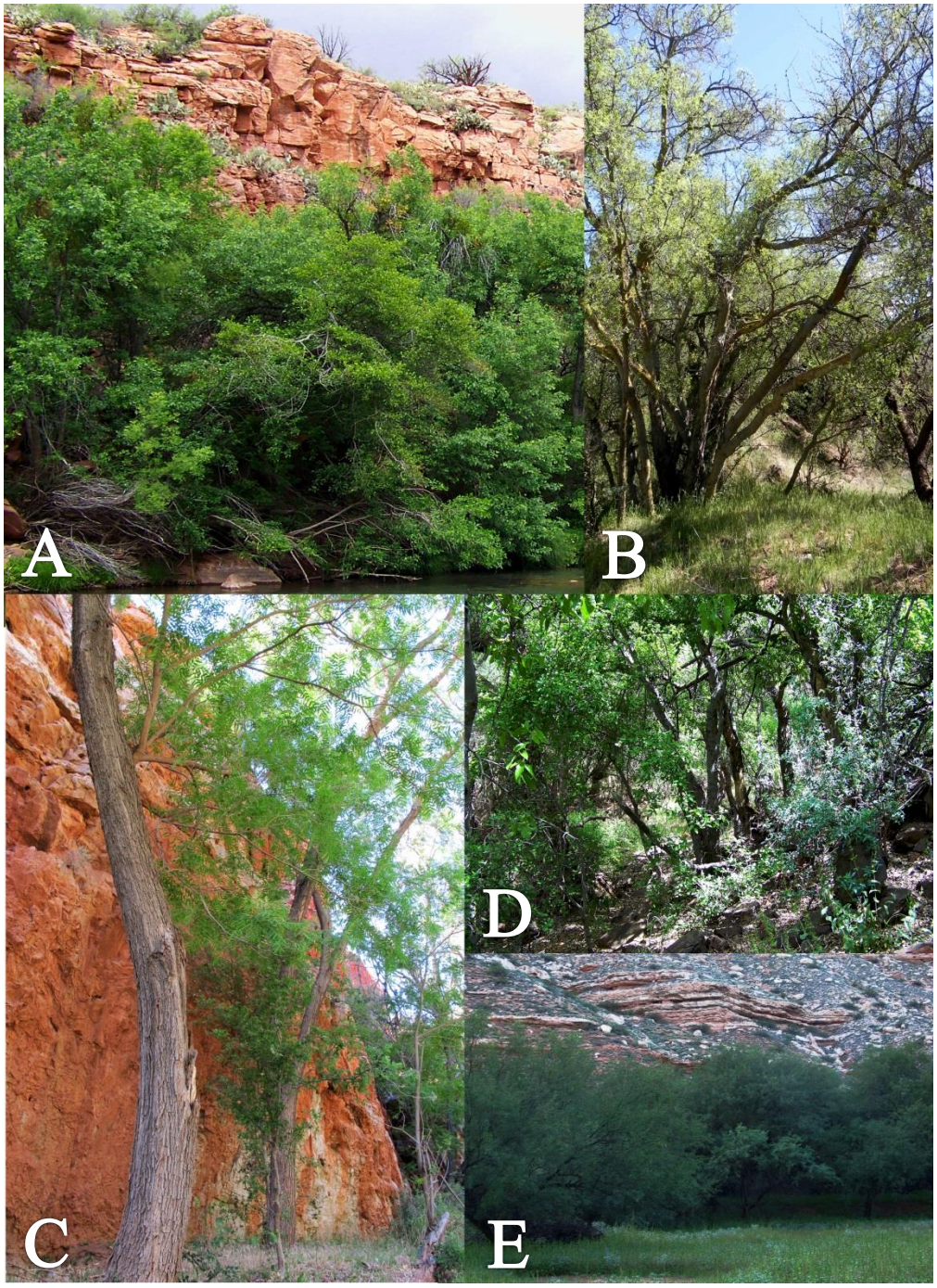

Figure 32. Various associations of Bosques and Mixed Riparian Scrub: A. Mixed scrub of *Acacia greggii*, *Celtis reticulata*, *Fraxinus velutina*, and *Prosopis velutina* near the Verde confluence with Sycamore Canyon. B. *Celtis reticulata* bosque on a sandy terrace. C. *Sapindus saponaria* forest on a high terrace near Perkinsville. D. Mesic Mixed Riparian Shrubland near Sycamore Canyon with *Berberis haematocarpa*, *Celtis reticulata*, *Penstemon pseudospectabilis*, and *Ziziphus obtusifolia*. E. Mesquite bosque on a terrace near TAPCO north of Clarkdale with *Prosopis velutina*.

ciliata, and *Phacelia rupestris. Eriogonum heermannii* ssp. *argense* is a regional endemic that is restricted to outcrops and cliffs near the headwaters. Other species that occur in the surrounding landscape are frequent such as *Aristida purpurea, Echinocereus coccineus, Nicotiana obtusifolia, Maurandya antirrhiniflora*, *Polygala alba*, *P. barbeyana*, and *Thamnosma texana.*

Orchards or Agricultural

Agricultural areas are rare in the study reach but an orchard consisting of grape Vitis arizonica (Arizona canyon grape), *Punica granatum* (pomegranate), and scattered *Prunus persica* (pear) occurs near the town of Sycamore upstream from the Sycamore Canyon confluence.

Figure 33. Dolostone Cliffs with *Petrophyton caespitosum*, *Aristida purpurea*, and *Castilleja chromosa* growing from cracks.

CHAPTER 5

DISCUSSION

Factors Influencing Species Richness

The Upper Verde River has an especially species-rich flora for an area of approximately 193 km^2 and an elevation range of 396 m. For context, consider the flora of the San Pedro Riparian National Conservation Area (Makings 2003) in the Sky Island region, an area increasingly recognized as a biodiversity hotspot (Van Devender et al. 2013b). The San Pedro is of a similar size (192 km^2) and elevation range (~ 302 m) with 620 taxa documented during a period of three years. Glen Canyon National Recreation Area—a park with an area of ~5000 km^2, roughly 25 times greater than that of the Upper Verde and a much broader elevation range (1370 m)—possesses 856 taxa, 236 more species than the Verde study area, a smaller difference than one would expect from such a dramatic difference (Hill and Ayers 2009).

The species richness of the Upper Verde region is influenced by several factors, the four most important I discuss here: 1) its location at the junction of three physiographic and floristic provinces, 2) topographic complexity and a variety of habitats for plants to colonize, 3) a mosaic of distinct geological formations; and 4) plant introductions due to modern humans and dense pre-Columbian inhabitation of the area.

Junction of Three Physiographic and Floristic Provinces

The main physiographic provinces of the southwestern United States—the Basin and Range, Colorado Plateau, and Central Highlands—possess distinct climatic regimes, and physical barriers to impede animal and plant dispersal. As a result, provinces possess largely distinct floras and faunas comprised of high numbers of endemic species (Shreve

1942, Axelrod and Raven 1985, McLaughlin 1986). McLaughlin (1986, 1992) conducted a phytogeographic analysis of 101 southwestern floras and defined five Floristic Provinces largely coinciding with regional physiographic provinces: 1) the Cordilleran, including the high mountain regions throughout the southwest and Rocky Mountains, 2) the Intermountain, largely aligned with the Colorado Plateau and Great Basin and stretching north to parts of Montana and Wyoming, 3) the Sonoran, including the Sonoran and Mojave Deserts and largely tied to the Southern Basin and Range, 4) the Chihuahuan, including the Chihuahuan Desert, and 5) the Madrean, coinciding with the Central Highlands extending to the Madrean Archipelago that stretches into northern Mexico (Figure 34).

The Upper Verde River lies at the meeting of the Intermountain, Sonoran and Madrean Floristic Provinces (Figure 34). The Upper Verde is within the Madrean Province, the headwaters lie in a broad basin born on the Colorado Plateau and forms a connection via valleys to The Verde Valley, which is influemced by the Sonoran Desert (Stevens et al. 2008). This geographic connectivity, combined with an intermediate climate, has resulted in an ecclectic flora with taxa from all three floristic regions. A sample analysis of SEINet distribution maps of 270 species shows a strong pattern of floristic affinities to the three provinces. Roughly 65 taxa have affinities to the Madrean Province, 43 to the Intermountain Province, 54 to the Sonoran Province, and 108 to multiple provinces or with a widespread distribution (Table 9). Many of the dominant, common, infrequent, and endemic species have affinities to a specific floristic province resulting in local communities composed of plants from various regions (Table 9).

Intermountain Species

Intermountain species dominant in communities along the Upper Verde include *Berberis fremontii*, *Forestiera pubescens*, *Juniperus osteosperma*, *Pinus edulis*, and *Purshia stansburiana*. Common species include *Euphorbia fendleri*, *Ephedra viridis,* and *Yucca angustissima*. Regional endemics of the Intermountain region include *Abronia nana* and *Penstemon ophianthus.*

Sonoran Species

Dominant species representing Sonoran affinities along the Upper Verde include *Acacia greggii*, *Chilopsis linearis*, *Fouquieria splendens*, *Opuntia engelmannii*, *Prosopis velutina*, *Tiquilia canescens,* and *Ziziphus obtusifolia.* Common species include *Acourtia wrightii*, *Baccharis sarothroides*, *Cylindropuntia leptocaulis,* and *Bouteloua aristidoides.*

Madrean Species

Many communities are dominated by Madrean Province species and common taxa include *Dalea formosa*, *Fraxinus velutina*, *Juglans major*, *Mimosa biuncifera,* and *Platanus wrightii*. Common species include *Acalypha neomexicana*, *Garrya wrightii*, *Ipomoea cristulata,* and *Nolina microcarpa*. Endemics to this region include *Alnus oblongifolia*, *Amsonia palmeri,* and *Perityle ciliata*.

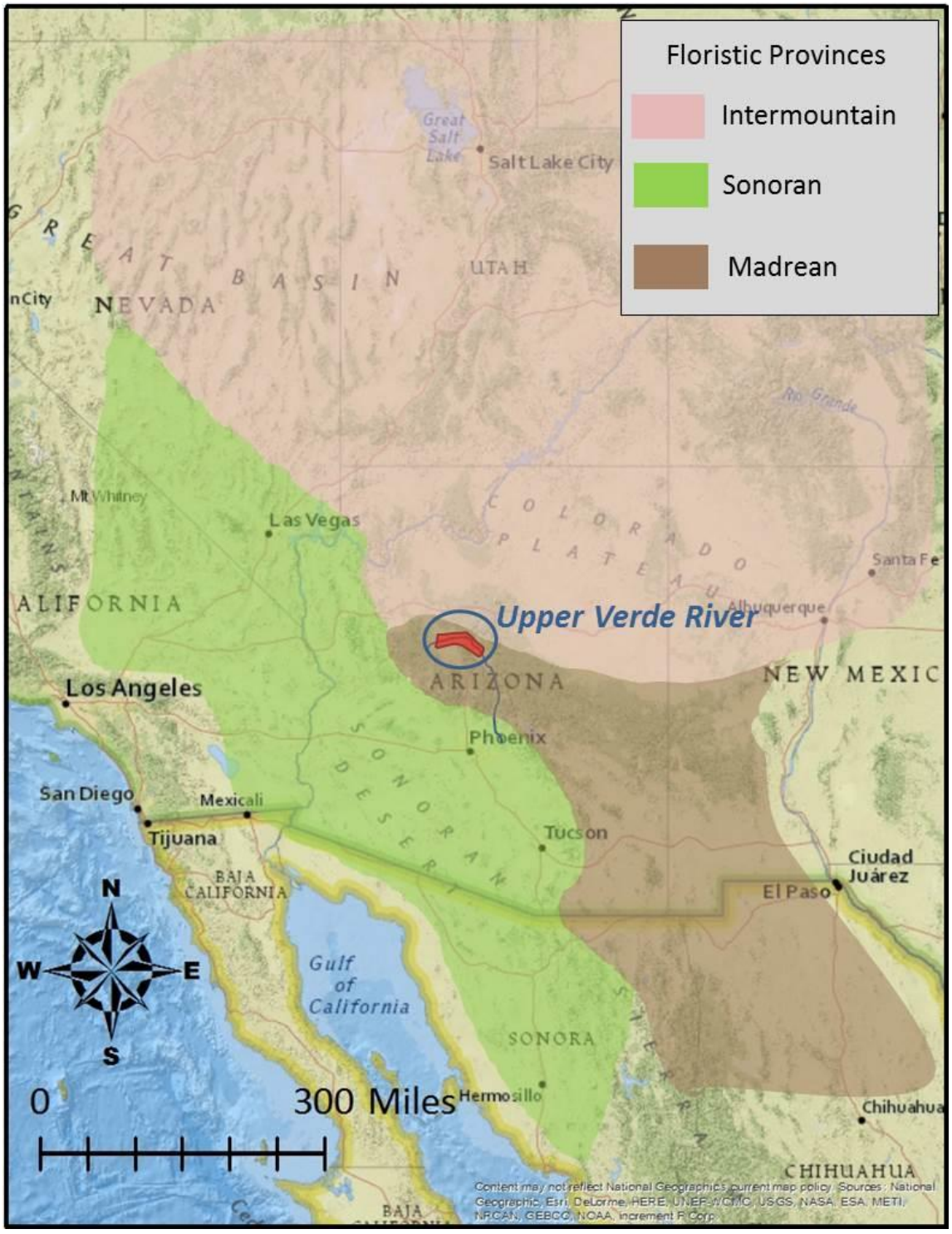

Figure 34. Floristic Provinces of the southwest after McLaughlin (1992) showing the Upper Verde River at the junction of three provinces.

Table 9. Examples of taxa in the flora with affinities to the three Floristic Provinces from SEINet distribution maps.

Madrean Province		Sonoran Province		Intermountain Province	
Family	**Taxon**	**Family**	**Taxon**	**Family**	**Taxon**
APOCYNACEAE	*Amsonia palmeri*	AIZOACEAE	*Trianthema portulacastrum*	APIACEAE	*Lomatium foeniculaceum subsp. macdougalii*
APOCYNACEAE	*Funastrum crispum*	AMARANTHACEAE	*Amaranthus fimbriatus*	APOCYNACEAE	*Asclepias latifolia*
APOCYNACEAE	*Matelea producta*	AMARANTHACEAE	*Atriplex elegans*	ASPARAGACEAE	*Androstephium breviflorum*
ASPARAGACEAE	*Agave parryi*	APOCYNACEAE	*Asclepias nyctaginifolia*	ASPARAGACEAE	*Yucca angustissima*
ASPARAGACEAE	*Nolina microcarpa*	ASTERACEAE	*Acourtia wrightii*	ASTERACEAE	*Artemisia campestris*
ASTERACEAE	*Baccharis pteronioides*	ASTERACEAE	*Adenophyllum porophylloides*	ASTERACEAE	*Brickellia microphylla var. scabra*
ASTERACEAE	*Brickellia eupatorioides var. chlorolepis*	ASTERACEAE	*Ambrosia monogyra*	ASTERACEAE	*Ericameria nauseosa var. oreophila*
ASTERACEAE	*Perityle ciliata*	ASTERACEAE	*Baccharis brachyphylla*	ASTERACEAE	*Hymenoxys cooperi*
BERBERIDACEAE	*Berberis haematocarpa*	ASTERACEAE	*Baccharis sarothroides*	ASTERACEAE	*Symphyotrichum lanceolatum var. hesperium*
BORAGINACEAE	*Plagiobothrys tenellus*	ASTERACEAE	*Logfia filaginoides*	ASTERACEAE	*Tetraneuris acaulis var. arizonica*
BRASSICACEAE	*Physaria cinerea*	ASTERACEAE	*Porophyllum gracile*	BORAGINACEAE	*Cryptantha cinerea*
CONVOLVULACEAE	*Evolvulus nuttallianus*	BIGNONIACEAE	*Chilopsis linearis*	BORAGINACEAE	*Cryptantha crassisepala*
CONVOLVULACEAE	*Evolvulus sericeus*	BORAGINACEAE	*Cryptantha barbigera*	BORAGINACEAE	*Cryptantha gracilis*
CONVOLVULACEAE	*Ipomoea cristulata*	BORAGINACEAE	*Cryptantha nevadensis*	BRASSICACEAE	*Streptanthus cordatus*
CYPERACEAE	*Cyperus fendlerianus*	BORAGINACEAE	*Eucrypta micrantha*	CLEOMACEAE	*Peritoma serrulata*
EUPHORBIACEAE	*Acalypha neomexicana*	BORAGINACEAE	*Pectocarya setosa*	EUPHORBIACEAE	*Euphorbia fendleri*
EUPHORBIACEAE	*Euphorbia revoluta*	BORAGINACEAE	*Plagiobothrys arizonicus*	EUPHORBIACEAE	*Euphorbia glyptosperma*
EUPHORBIACEAE	*Euphorbia stictospora*	BRASSICACEAE	*Thysanocarpus curvipes*	FABACEAE	*Astragalus calycosus var. scaposus*
FABACEAE	*Dalea albiflora*	CACTACEAE	*Cylindropuntia leptocaulis*	FABACEAE	*Astragalus newberryi*
FABACEAE	*Desmanthus cooleyi*	CACTACEAE	*Opuntia engelmannii*	FABACEAE	*Dalea searlsiae*
FABACEAE	*Desmodium neomexicanum*	CAMPANULACEAE	*Nemacladus glanduliferus*	FABACEAE	*Glycyrrhiza lepidota*
FABACEAE	*Rhynchosia senna*	CELASTRACEAE	*Canotia holacantha*	GENTIANACEAE	*Frasera albomarginata*
FABACEAE	*Senna bauhinioides*	CUCURBITACEAE	*Marah gilensis*	GROSSULARIACEAE	*Ribes cereum*
FABACEAE	*Vicia ludoviciana*	EUPHORBIACEAE	*Euphorbia hyssopifolia*	LAMIACEAE	*Dracocephalum parviflorum*
FAGACEAE	*Quercus palmeri*	EUPHORBIACEAE	*Euphorbia micromera*	NYCTAGINACEAE	*Abronia nana*
GARRYACEAE	*Garrya wrightii*	FABACEAE	*Astragalus didymocarpus*	ONAGRACEAE	*Oenothera flava*
JUGLANDACEAE	*Juglans major*	FABACEAE	*Lupinus concinnus*	OROBANCHACEAE	*Cordylanthus parviflorus*
LILIACEAE	*Calochortus kennedyi*	FABACEAE	*Prosopis velutina*	PLANTAGINACEAE	*Penstemon ophianthus*
NYCTAGINACEAE	*Mirabilis coccinea*	FOUQUIERIACEAE	*Fouquieria splendens*	PLANTAGINACEAE	*Penstemon rostriflorus*
PLATANACEAE	*Platanus wrightii*	MALPIGHIACEAE	*Cottsia gracilis*	PLANTAGINACEAE	*Penstemon thompsoniae*
POACEAE	*Bouteloua hirsuta*	NYCTAGINACEAE	*Boerhavia coccinea*	POACEAE	*Achnatherum hymenoides*
POACEAE	*Hopia obtusa*	NYCTAGINACEAE	*Boerhavia intermedia*	POACEAE	*Leymus cinereus*
POACEAE	*Muhlenbergia emersleyi*	ONAGRACEAE	*Eremothera chamaenerioides*	POACEAE	*Pascopyrum smithii*
PTERIDACEAE	*Cheilanthes fendleri*	OROBANCHACEAE	*Castilleja exserta*	POLYGONACEAE	*Eriogonum alatum*
SOLANACEAE	*Solanum americanum*	PAPAVERACEAE	*Platystemon californicus*	POLYGONACEAE	*Eriogonum microthecum var. simpsonii*
VIOLACEAE	*Hybanthus verticillatus*	POACEAE	*Bouteloua aristidoides*	ROSACEAE	*Amelanchier utahensis*
		POACEAE	*Digitaria californica*	ROSACEAE	*Chamaebatiaria millefolium*
		POACEAE	*Muhlenbergia porteri*	ROSACEAE	*Petrophytum caespitosum*
		POLYGONACEAE	*Eriogonum deflexum*		
		PTERIDACEAE	*Pellaea truncata*		
		RHAMNACEAE	*Ziziphus obtusifolia*		
		URTICACEAE	*Parietaria hespera*		
		ZYGOPHYLLACEAE	*Kallstroemia californica*		

Topographic and Habitat Complexity

Topographic and habitat complexity contribute significantly to the richness of species along the Upper Verde. This is a landscape of abruptly changing topography in the form of steep slopes, winding canyons, cliffs, mesas, valley flats, and rolling hillsides (Figure 1 and 4). The river shapes the landscape in many ways, by cutting canyons and lowering the stream bed so that tributaries become deeply incised, and by depositing large amounts of sediment creating topographical and edaphic changes along its path. This spatial heterogeneity allows plants adapted to a myriad of environments to colonize and thrive.

Perennial surface water and shallow groundwater allows for the presence of 94 obligate and facultative wetland species and many of the additional 175 facultative and facultative upland species primarily occur due to the mesic environments created by canyons and riparian foliage. This range in water availability has a sharp effect on the distribution and composition of species. Plants near the stream rely on year-round surface water while some of the larger trees and shrubs away from the stream need only high water tables. In the uplands, many spring ephemerals occur which are limited by pulses of winter and spring precipitation. Many late-summer ephemerals occur too that are restricted to regions with monsoonal rain patterns. These distinct communities are adapted to disparate timing and rates of water availability. Thus temporal and spatial heterogeneity of water availability accounts for a large amount of species diversity in the area.

The 12 vegetation types along the Upper Verde reflect broader geographic biotic communities whose range and composition is limited by climate, topography and edaphic

conditions (Brown 1982). The presence of these diverse regional influences provides a source of species from disparate regions. The distinct communities are often associated with particular soils and slopes. For instance, grasslands typically occur on flat mesa-tops while the presence of steeper north-facing slopes facilitates the occurrence of Interior Chaparral with species such as *Ceanothus greggii* that are otherwise uncommon. Across the canyon on south facing slopes will be dominated by Chihuahuan/Apacherian Desert Scrub with dense thickets of cacti will abound. Species restricted to Cliffs and Rock Outcrops such as *Cheilanthes feei*, *Petrophytum caespitosum*, *Perityle ciliata*, and *Chamaebatiaria millefolium* would not occur if abrupt uplifted sedimentary formations, rock mesas formed by ancient lava flows, and craggy canyons formed by stream incision were not present. Thus, the interaction between diverse topography, habitat availability, and regional influences significantly enhaneces the floristic diversity.

Geologic Diversity and Edaphic Affinities

The edaphic factor is a primary determinant of plant distributions and diversity (Kruckeberg 2004). Nutrient-poor soils such as limestones, serpentine and gypsum in particular are important in driving evolution of edaphic endemic species, lineages, and entire floras (Kruckeberg 2004, Rajakaruna 2004, Moore et al. 2014).

Geologic formations and their endemic floras contribute to regional diversity in many parts of the world, including biodiversity hotspots such as the California and Cape Floristic Provinces. In the arid Southwest United States and Northern Mexico, geologic richness has given rise to substrate-specific floras and edaphic endemics including those of gypsum and limestone in the Chihuahuan Desert (Van Devender et al. 2013b, Moore et al. 2014), the fresh-water limestones of the Sonoran Desert (Anderson 1996, 2011) and

plants of various sedimentary formations on the Colorado Plateau (Welsh and Atwood 2007). The edaphic factor has a large influence on the flora of the Upper Verde as well, as a portion of the flora is restricted to one or few- geologic formations or soil types. The presence of a variety of geologic formations and their floristic disparities significantly enhances the species richness of the flora.

In the study area, there are twelve geological formations important to plants (Table1, Figure 35) (DeWitt et al. 2008). Fifty-five species were primarily restricted to limestones (Table 10). Twenty-nine of these taxa are on the periphery of their range, and 15 are disjunct from their center of distribution, in keeping with Raven's (1964) tenet that species will occupy harsh edaphic environments on the edges of their ranges as these habitats provide a refuge from competition with the surrounding dominant vegetation. Of the 48 localized and regional endemics in the Upper Verde flora, 13 were found primarily on limestone, dolostone or calcareous soils. Four of the seven US Forest Service Sensitive species are restricted to calcareous substrates: *Eriogonum ripleyi, Pediomelum verdiense*, *Rhinotropis* (*Polygala*) *rusbyi*, *Salvia dorrii* subsp. *Mearnsii* (Figure 16), and the only Endangered species in the area, *Purshia subintegra*, is restricted to the Verde Formation lacustrine limestone in the Verde Valley.

Limestone plants in the region have strong affinities to the Great Basin Desert and Colorado Plateau to the north, with a few species most common in the southern Chihuahuan desert. Notable examples from the northern deserts include *Abronia nana*, *Chamaebatiaria millefolium*(Figure 36), *Escobaria (Coryphantha) missouriensis* (Figure 20) , and *Penstemon thompsoniae* (Figure 36) and examples from the Chihuahuan region

include the common *Parthenium incanum* and more infrequent *Clorodendrum* (*Tetraclea*) *coulteri* (Figure 36).

Thirty-two species were found only in a small section of the study area near Rio Verde Ranch across three formations with coarse neutral soils: Verde granite, gabbro and Tapeats sandstone. Fourteen are in marginal populations on the northern edges of their range, 17 are disjuncts and one a central Arizona endemic, *Eremogone aberrans*. Species on these formations tend to have affinities to southeastern Arizona and the Sonoran and Mojave deserts; as opposed to the northern affinity of limestone plants. Examples of these include *Euphorbia indivisa* (Figure 18), *Gomphrena caespitosa*, *Portulaca suffrutescens*, and *Schistophragma intermedia* (Figure 37). The basalt also possessed a relatively distinct flora. Two species only found on basalt formations were *Pectis prostrata* and *Kallstroemia grandiflora.*

Edaphic heterogeneity also explains other distributions. Areas of sandy deposits, for example, are the primary valley-bottom host for multiple species of *Cryptantha* and *Lupinus* in the spring. In the monsoonal summer, these sand deposits become dense with annual grasses such as *Bouteloua barbata, B. aristoides*, *Eragrostis cilianensis*, *E. pectinacea*, and *E. mexicana* and forbs such as species of *Euphorbia*. The sandy areas are just one example, as the river bottom consists of mosaics of silts, clays, interspersed with rocky, gravelly and cobbly areas, and saline catchments with varying amounts of moisture.

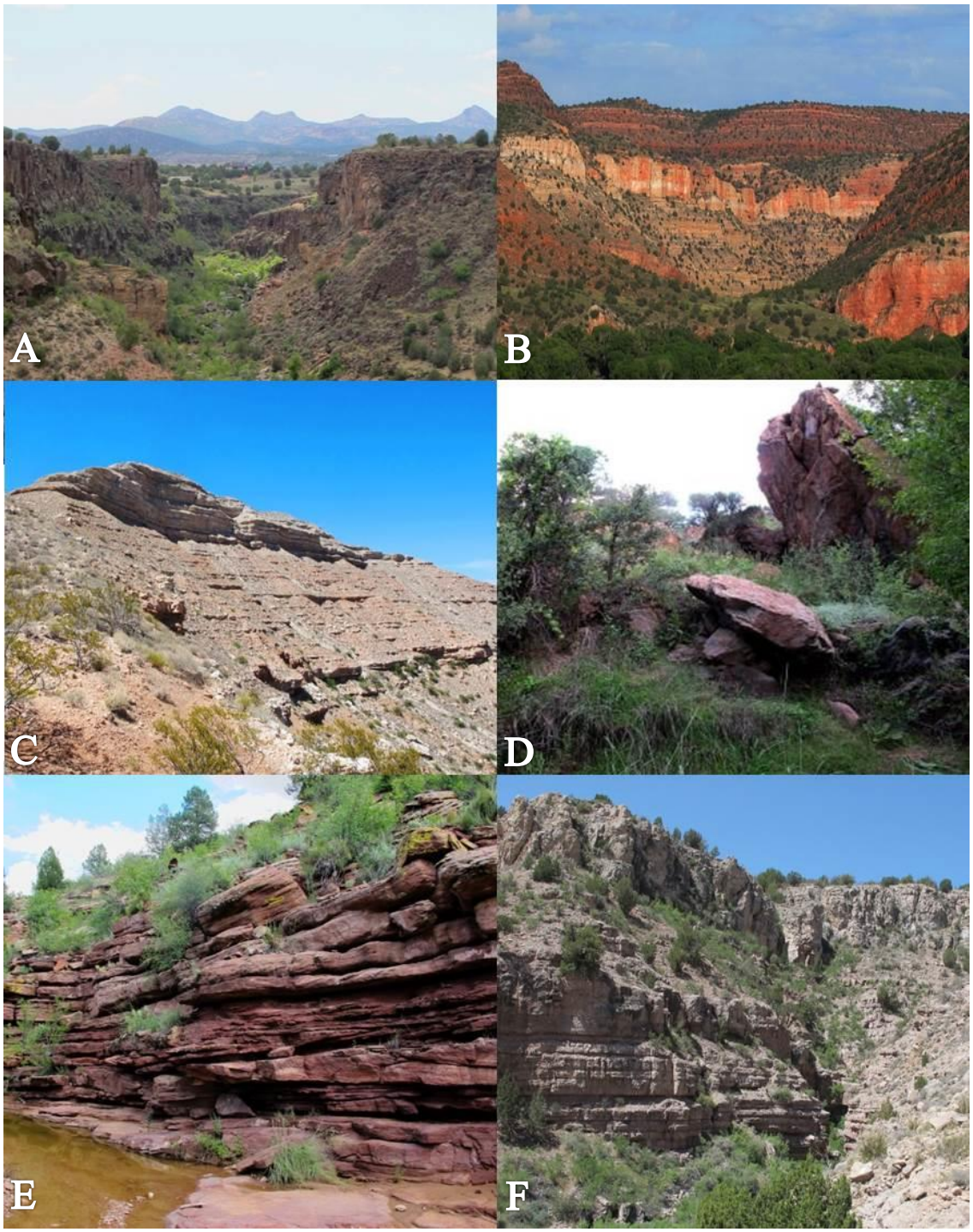

Figure 35. Photos of geologic formations important to plant distribution along the Upper Verde. A. Perkinsville Basalt at Sullivan's Canyon. B. Supai group on top of Redwall Limestone at Perkinsville. C. Verde Formation Limestone near Clarkdale. D. Verde Gabbro and Granodiorite near Bull Basin. E. Tapeats Sandstone near Rio Verde Ranch. F. Martin Formation Dolostone near the Upper Verde River Springs.

Table 10. Plants of the Upper Verde River flora primarily occurring on limestone and dolostone (left) and igneous and Tapeats sandstone (right).

Limestone and Dolostone		Igneous or Tapeats Sandstone	
Family	**Taxon**	**Family**	**Taxon**
Apocynaceae	*Asclepias involucrata*	Amaranthaceae	*Amaranthus fimbriatus*
Asteraceae	*Acourtia nana*	Amaranthaceae	*Gomphrena caespitosa*
Asteraceae	*Erigeron concinnus*	Asteraceae	*Logfia filaginoides*
Asteraceae	*Melampodium leucanthum*	Asteraceae	*Porophyllum gracile*
Asteraceae	*Parthenium incanum*	Boraginaceae	*Cryptantha cinerea var. cinerea*
Asteraceae	*Tetraneuris acaulis var. arizonica*	Boraginaceae	*Cryptantha circumscissa*
Asteraceae	*Thymophylla acerosa*	Boraginaceae	*Cryptantha micrantha*
Boraginaceae	*Tiquilia canescens*	Caryophyllaceae	*Eremogone aberrans*
Brassicaceae	*Physaria arizonica*	Commelinaceae	*Commelina dianthifolia*
Brassicaceae	*Streptanthus cordatus*	Convolvulaceae	*Evolvulus sericeus*
Cactaceae	*Escobaria missouriensis*	Cyperaceae	*Cyperus fendlerianus*
Celastraceae	*Canotia holacantha*	Cyperaceae	*Cyperus squarrosus*
Convolvulaceae	*Evolvulus nuttallianus*	Euphorbiaceae	*Euphorbia indivisa*
Crossosomataceae	*Glossopetalon spinescens*	Fabaceae	*Astragalus didymocarpus*
Euphorbiaceae	*Chamaesyce fendleri*	Fabaceae	*Chamaecrista nictitans*
Fabaceae	*Acmispon mearnsii var. mearnsii*	Fabaceae	*Dalea albiflora*
Fabaceae	*Astragalus calycosus var. scaposus*	Fabaceae	*Desmodium neomexicanum*
Fabaceae	*Astragalus newberryi*	Fabaceae	*Ottleya oroboides (Lotus plebius)*
Fabaceae	*Dalea formosa*	Lamiaceae	*Hedeoma oblongifolium*
Fabaceae	*Pediomelum verdiense*	Malvaceae	*Anoda pentaschista*
Fouquieriaceae	*Fouquieria splendens*	Molluginaceae	*Mollugo cerviana*
Gentianaceae	*Frasera albomarginata*	Molluginaceae	*Mollugo verticillata*
Lamiaceae	*Clerodendrum coulteri*	Montiaceae	*Phemeranthus parviflorus*
Lamiaceae	*Salvia dorrii ssp. mearnsii*	Onagraceae	*Eremothera chamaenerioides*
Liliaceae	*Calochortus flexuosus*	Plantaginaceae	*Schistophragma intermedia*
Nyctaginaceae	*Abronia nana*	Poaceae	*Lycurus setosus*
Orobanchaceae	*Cordylanthus laxiflorus*	Polemoniaceae	*Leptosiphon aureus*
Plantaginaceae	*Penstemon thompsoniae*	Portulacaceae	*Portulaca suffrutescens*
Poaceae	*Digitaria cognata*		
Poaceae	*Panicum hallii*		
Polygalaceae	*Polygala alba*		
Polygalaceae	*Polygala barbeyana*		
Polygalaceae	*Polygala rusbyi*		
Polygonaceae	*Eriogonum alatum*		
Polygonaceae	*Eriogonum heermannii var. argense*		
Polygonaceae	*Eriogonum ripleyi*		
Pteridaceae	*Astrolepis integerrima*		
Rosaceae	*Chamaebatiaria millefolium*		
Rosaceae	*Petrophytum caespitosum*		
Rosaceae	*Purshia X subintegra*		
Rubiaceae	*Houstonia rubra*		
Rutaceae	*Thamnosma texana*		

Figure 36. Plants Occurring on Limestone. A.*Penstemon thompsoniae* on rocky Martin Formation dolostone near the headwaters. B. *Houstonia rubra* on gravelly limestone and dolostones soils near the headwaters. C. *Tetraclea coulteri* on Martin Formation dolostone .D. *Chamaebatiaria millefolium* on dolostones cliffs near the headwaters. E. *Thymophylla acerosa* is common such as here in the Verde Valley on Verde Formation limestone. F. *Thamnosma texana* on dolostones near the headwaters.

Figure 37. Plants Occurring on Granite, Gabbro, and Tapeats Sandstone.A and B. *Phemeranthus parviflorus*. C. Regional Madrean endemic *Gomphrena caespitosa*. D. *Schistophragma intermedia*, more common in southeastern Arizona and Mexico. E. *Portulaca suffrutescens*, endemic to the Madrean Province and northern Mexico.

Introductions by Contemporary and Pre-Columbian Cultures

Humans have had a significant impact on landscapes and the floras of regions since pre-history. Impacts to species diversity are especially evident in areas such as the Upper Verde River where abundant resources have supported human cultures continuously for nearly 1000 years **(**Fish 1974**)**. Along the Upper Verde, 97 taxa, 13% of the flora, was introduced to the continent via humans since European contact and many of these species spread to the region with the help of humans and their vectors such as roads, railways, machinery and livestock. Many have become naturalized in the area. Some dominate localized areas such as riparian zones covered in *Bromus rubens*, *B. diandrus* and *Melilotus officinalis*, while others are minor components of the landscape. Some were even planted by settlers such as *Punica granatum* (pomegranate) and *Prunus persica* (pear).

Before European arrival, pre-Columbian indigenous cultures significantly influenced the landscape and distribution of plants throughout the southwest, including the Upper Verde River region. The entire Upper Verde is lined with habitation sites, hilltop defensive compounds, agricultural terraces, and rock-art sites. Habitation sites number in the hundreds and range from one-room pit houses to pueblo complexes of 20-40 rooms (Fewkes 1876, Fish 1976, personal observations). Populations of pre-Columbian *Agave* domesticates occur near archaeological sites throughout the Verde Valley including along the Upper Verde River, and new species have been recently described from the area (Hodgson and Salywon 2013). The likihood that many other species were transported, cultivated or encouraged in the area is high considering the extent to which pre-Columbians utilized and manipulated plant resources.

Many food plants that were wild harvested or encouraged around villages are now common including *Amaranthus* spp, *Chenopodium* spp., *Helianthus annuus, Physalis* spp*, Plantago* spp., *Portulaca oleracea*, and various mustards (e.g., *Lepidium, Descurainia*). Trees and shrubs were important for fruit and seed crops including *Acacia greggii*, *Juglans major*, *Lycium* spp., *Morus microphylla*, *Prosopis velutina*, and *Quercus* spp. (Fish 1974, Hodgson 2001). Abundant riparian species were harvested including *Typha domingensis* for seeds and starchy roots; *Juncus* and *Schoenoplectus* spp. for starchy stems and roots; and grasses such as *Hesperostipa*, *Hordeum,* and *Sporobolus* for grain.

Multiple species such as *Hordeum pusillum* were domesticated in the region (Fish 2004) and it is likely other manipulated plants have been overlooked. During this study, populations of the wild species *Agave parryi* were found near village sites but were notably absent in the surrounding landscape. Parker et al. (2010) found that central Arizona populations of *A. parryi* near archaeological sites differed significantly from wild populations genetically, morphologically and in sugar content, indicating selection, planting and trading. The Upper Verde populations may have been purposefully introduced and planted near villages.

Another notable finding was *Phaseolus acutifolius* var *latifolius* (Figure 38). The "tepary bean" has been wild-harvested and cultivated throughout the Americas for over 5,000 years and is still dry-farmed today (Nabhan and Teiwes 1983, Hodgson 2001, Fish 2004). The two localities at Perkinsville and in the Black canyon of the Verde Valley are in areas of extensive prehistoric habitation, and the two nearest populations are over 129 km to the southwest in the Tonto Basin, one of the densest pre-Columbian areas in the

southwest. These areas were connected via trade routes used to transport *Agave* and it is likely other species were carried such as the tepary bean (Gregory 1991).

Other taxa have distributions indicating human-assisted migration. *Scutellaria lateriflora* (blue skullcap) (Figure 19) is a widely used traditional medicinal herb (Hamel and Chiltoskey 1975) with a population in eastern Arizona but otherwise disjunct over 650 km to the Midwestern US. It is common along streambanks in a stretch dense with archaeological sites. *Lycopus asper* is a food plant used by Great Plains tribes and found in archaeological remains in Montana (Dexter et al. 2014). The Upper Verde is one of its two localities in Arizona and it was only found near prehistoric villages. *Urtica dioica* subsp. *gracilis* (stinging nettle), a traditional medicinal and edible plant was found at one location along the river below an *Agave* cultivation site. *Peritoma* (*Cleome*) *serrulata* (Figure 39) is a common food source of greens and seeds planted by Hopi, Navajo and other western tribes (Hodgson 2001). It only occurs at two localities along the Verde, both along the river at dense archaeological areas. *Porophyllum gracile* is more common in the Sonoran Desert and absent from the Upper Verde except for one locality upslope from a dense archaeological site. It has extensive use as a medicinal herb today by indigenous people in Mexico (Yetman and Van Devender 2002).

Although further studies are needed to confirm human introduction is responsible for the presence of these and other plants, there is little question both contemporary and pre-Columbian cultures have left a significant mark on the floristic composition and richness of the region.

Figure 38. *Phaseolus acutifolius* var. *latifolius*, a possible relict from pre-Columbian cultivation in the Verde Valley.

Figure 39. *Peritoma serrulata*, an important source of greens and grains to prehistoric and modern Puebloans, uncommon in the region and only found near archaeological sites along the Upper Verde.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Summary

The Upper Verde River area is highly important to the region yet its floristic composition and diversity was previously unknown. My 1856 collections resulted in a flora of 729 taxa in 404 genera and 98 families.

Verde stream flows have declined over the past century and are predicted to recede further under current rates of water use in the region. An inventory of the number of wetland species, their proportion of the flora and their water needs establishes a baseline for future comparisons and provides a direct measure of the plant diversity sustained by stream flows and high water tables. The Flora possesses 94 combined obligate and facultative wetland taxa which are mostly restricted to wetlands, and an additional 175 taxa that either primarily to frequently occur in riparian areas. Thus 269 taxa, 37 % of the flora are either supported by wetlands, mesic riparian environments or occur in riparian areas.

The area has long been known as a hotspot of plant endemism and this study documented new populations and range extensions of several endemic taxa, documenting the endemic richness of the area for the first time. Thirty nine regional and 9 localized endemics were found representing 7% of the flora. Twenty six species are of conservation concern, 7 of which are US Forest Service Sensitive and 1 federally Endangered. Of these, 15 are restricted to a particular geologic type (primarily limestone). In addition, I found many new populations of introduced species.

The Verde region possesses a diverse array of plant communities, which contribute to the area's diversity. I described 13 distinct types: 1) Pinyon Juniper Woodland, 2) Chihuahuan/Apacherian Scrub, 3) Sonoran Scrub, 4) Interior Chaparral, 5) Plains Grassland, 6) Semidesert Grassland, 7) Marshes and Streamside Wetlands 8) Riparian Woodland and Shrubland, 9) Riparian Meadows, 10) Dry Floodplains and Washes, 11) Bosques and Mixed Riparian Scrub, 12) Cliffs and Rocky Outcrops, and 13) Orchards and Agricultural. The most common and widespread community types are Pinyon Juniper Woodland, Chihuahuan/Apacherian Scrub, and Riparian Woodland and Shrubland.

The species richness of this unique region is influenced by multiple factors, the most important of which are 1) the junction of three physiographic and Floristic Provinces, 2) topographic and habitat complexity, 3) geologic diversity and edaphic affinities, and 4) human introductions by contemporary and pre-Columbian cultures. Two taxa documented are known to be cultivated pre-historically and many more were likely introduced to the area, planted near dwellings and exist as relicts today.

Future Research Directions

The unique Upper Verde flora provides many future research opportunities. Now that a complete checklist exists, research in the vein of past work (e.g. Leroy et al. 2006) linking plant species composition and diversity to higher trophic and ecosystem-level functions will have a thorough species composition framework to work with. Species composition along the Verde can be linked with ecosystem functions (e.g. nutrient cycling, soil stabilization) and diversity (e.g. macro-invertebrate and wildlife) to predict potential effects from loss of populations of specific plant species due to dewatering.

Although research has focused on other edaphic floras, the evolution and ecology of central Arizona geofloras has been under-studied. A better understanding of the environmental niches, systematics, biogeography and adaptation of edaphically-restricted taxa will allow us to predict the fate of important plant species in the face of climate change and habitat loss.

The Upper Verde is an excellent model system to study the effects of pre-Columbian human influence on plant distributions. Population genetic studies of plants associated with archaeological sites would give insight into which plants were transported and planted, their geography and cultural affiliations, and the genetic and phenotypic changes associated with selection and cultivation.

Conservation Recommendations

The Upper Verde is in need of a number of conservation actions. First, the watershed has been the focus of extensive efforts to remove exotic species and mitigate their potential ecological impacts yet little has been done to restore plant diversity and ecosystem integrity in highly disturbed habitats such as riparian grasslands and springs. My field data and observations indicate that commonly targeted species such as *Ailanthus altissima* (tree of heaven), *Arundo donax* (giant reed), *Elaeagnus angustifolia* (Russian olive), and *Tamarix chinensis* (tamarisk) occur in small, isolated patches with low numbers of individuals. Few patches of tamarisk were found (partially due to past removal) and the others primarily occurred as an occasional single tree. Tamarisk is unlikely to replace cottonwood and willow where flood regimes and high water tables are maintained (Stromberg et al. 2007), so populations will likely remain at low levels unless Verde flows become intermittent and water tables decline.

In many areas past land-use such as off road recreation and cattle grazing has negatively impacted plant diversity and abundance and soil stability. Although vehicles and cattle are no longer allowed along the Verde River corridor many cows still make it to the river and streambanks and springs show evidence of intense trampling. Spring habitats are especially in need of restoration and fencing since they host wetland species not found along the main stream channel. High terraces along the river are in need of restoration. Many were historically Riparian Meadows (Neary et al. 2012) but channel incision has left them cut off from the stream, and grazing likely reduced xeric-adapted bunchgrasses leaving mostly exotic annuals of little resource value to wildlife or soil stabalization. Bunchgrasses with remnant patches in these habitats such as *Muhlenbergia asperifolia* and *Sporobolus airoides* could be used to restore these habitats back to productive, stable grasslands.

This study has provided land managers and law makers with a comprehensive picture of the area's floristic diversity and the potential impacts of dewatering, land use, and development. Establishing the Upper Verde as a Wild and Scenic River would set aside permanent habitat for the many species of animals and plants relying on the river and uplands. Many populations of infrequent plant taxa occur along the river and if flows diminish, significant portions of those species' ranges would be lost. In addition, many endemic and rarely-collected taxa occur in the uplands. Wild and Scenic designation would protect these species and their rippling influence at the ecosystem, local and regional levels.

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APPENDIX A

DEFINITION OF TERMS USED

Sources of information for the following terms are included in the Methods section.

Category	Description
Plant Duration	
Annual	Completes entire lifecycle in one growing season
Biennial	Lifecycle spans two years
Perennial	Lifecycle spans more than two years
Plant Growth form	
Forb/herb	Plant without significant woody tissue above or at the ground; may be annual, biennial, or perennial.
Graminoid	Grass or grass-like plant, including grasses (Poaceae), sedges (Cyperaceae), rushes (Juncaceae)
Shrub	Perennial woody plant that is usually less than 4 to 5 meters (13 to 16 feet) in height.
Subshrub	Low-growing shrub usually under 0.5 m (1.5 feet) tall, never exceeding 1 meter (3 feet) tall at maturity.
Tree	Perennial, woody plant with a single stem (trunk), normally greater than 4 to 5 meters (13 to 16 feet) in height but may be multi-stemmed or have a short growth form
Vine	Woody or herbaceous twining/climbing plant; includes herbs or shrubs that can have the tendency to be a vine
Native/Non-Native Status	
Native	Plants found in the US before the time of European contact
Non-Native/Introduced	A plant introduced to the US with human help after the time of European contact
Noxious Weed	environment
Wetland ratings	
OBL	Obligate - Almost always occur in wetlands
FACW	Facultative Wetland - Usually occur in wetlands, but may occur in nonwetlands
FAC	Facultative - Occur in wetlands and non-wetlands
FACU	Facultative Upland - Usually occur in non-wetlands, but may occur in wetlands
UPL	Upland - Almost never occur in wetlands
Nature Serve Global Ranks (G-Ranks)	
G1	Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	Imperiled—At high risk of extinction or elimination due to restricted range, few populations or populations or occurrences, very steep declines, very severe threats, or other factors.
G3	Vulnerable—At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
G4	Apparently Secure—At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats,
G5	Secure-Common, widespread andabundant
Nature Serve Subnational Ranks (S-Ranks)	
S1	Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the
S2	Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or
S3	Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	Common, widespread, and abundant in the nation or state/province.

APPENDIX B

CHECKLIST OF WETLAND TAXA

Each taxon is labeled with its wetland rank, after Lichvar et al. (2014) and native status, after NRCS-USDA(2015). Obligate, wetland (OBL), facultative wetland (FACW), facultative (FAC), and facultative upland (FACU) species are included.

Rank	Scientific Name	Native/Int	Rank	Scientific Name	Native/Int
OBL	*Alisma triviale*	Native	FACW	*Amorpha fruticosa*	Native
OBL	*Anemopsis californica*	Native	FACW	*Calibrachoa parviflora*	Native
OBL	*Berula erecta*	Native	FACW	*Carex praegracilis*	Native
OBL	*Bidens aurea*	Native	FACW	*Cyperus esculentus*	Non-Native
OBL	*Bidens laevis*	Native	FACW	*Cyperus niger*	Native
OBL	*Carex hystericina*	Native	FACW	*Cyperus odoratus*	Native
OBL	*Carex pellita*	Native	FACW	*Echinochloa crus-galli*	Non-Native
OBL	*Carex senta*	Native	FACW	*Eleocharis parishii*	Native
OBL	*Carex vulpinoidea*	Native	FACW	*Epilobium ciliatum*	Native
OBL	*Crypsis schoenoides*	Non-Native	FACW	*Equisetum laevigatum*	Native
OBL	*Cyperus squarrosus*	Native	FACW	*Eriochloa acuminata*	Native
OBL	*Eleocharis acicularis*	Native	FACW	*Euthamia occidentalis*	Native
OBL	*Eleocharis palustris*	Native	FACW	*Frangula californica*	Native
OBL	*Epipactis gigantea*	Native	FACW	*Gnaphalium palustre*	Native
OBL	*Erythranthe cordata*	Native	FACW	*Juncus balticus*	Native
OBL	*Erythranthe guttata*	Native	FACW	*Juncus mexicanus*	Native
OBL	*Hydrocotyle verticillata*	Native	FACW	*Juncus interior*	Native
OBL	*Juncus articulatus*	Native	FACW	*Juncus torreyi*	Native
OBL	*Juncus xiphioides*	Native	FACW	*Oenothera elata subsp. hirsutissima*	Native
OBL	*Leersia oryzoides*	Native	FACW	*Oenothera elata subsp. hookeri*	Native
OBL	*Lemna gibba*	Native	FACW	*Panicum virgatum*	Native
OBL	*Lemna valdiviana*	Native	FACW	*Paspalum distichum*	Native
OBL	*Lobelia cardinalis*	Native	FACW	*Persicaria lapathifolia*	Native
OBL	*Ludwigia peploides*	Native	FACW	*Phalaris arundinacea*	Native
OBL	*Lycopus asper*	Native	FACW	*Platanus wrightii*	Native
OBL	*Mentha spicata*	Non-Native	FACW	*Polygonum aviculare*	Non-Native
OBL	*Myriophyllum spicatum*	Non-Native	FACW	*Polypogon interruptus*	Native
OBL	*Nasturtium officinale*	Non-Native	FACW	*Polypogon monspeliensis*	Non-Native
OBL	*Nymphaea odorata*	Native	FACW	*Polypogon viridis*	Non-Native
OBL	*Persicaria amphibia*	Native	FACW	*Potentilla biennis*	Native
OBL	*Persicaria punctata*	Native	FACW	*Rumex mexicanus*	Native
OBL	*Potamogeton crispus*	Non-Native	FACW	*Rumex salicifolius*	Native
OBL	*Potamogeton foliosus*	Native	FACW	*Salix exigua*	Native
OBL	*Ranunculus cymbalaria*	Native	FACW	*Salix gooddingii*	Native
OBL	*Rorippa palustris*	Native	FACW	*Salix laevigata*	Native
OBL	*Samolus valerandi*	Native	FACW	*Scutellaria lateriflora*	Native
OBL	*Schoenoplectus acutus*	Native	FACW	*Trifolium mucronatum subsp. lacerum*	Native
OBL	*Schoenoplectus americanus*	Native	FACW	*Viola nephrophylla*	Native
OBL	*Schoenoplectus pungens*	Native	FACW	*Zeltnera calycosa*	Native
OBL	*Schoenoplectus tabernaemontani*	Native	FACW	*Arundo donax*	Non-Native
OBL	*Sisyrinchium demissum*	Native	FAC	*Allophyllum gilioides*	Native
OBL	*Symphyotrichum expansum*	Native	FAC	*Amaranthus crassipes*	Non-Native
OBL	*Symphyotrichum lanceolatum var. hesperium*	Native	FAC	*Ambrosia trifida*	Native
OBL	*Stuckenia filiformus*	Native	FAC	*Anoda cristata*	Native
OBL	*Stuckenia pectinata*	Native	FAC	*Apocynum cannabinum*	Native
OBL	*Typha domingensis*	Native	FAC	*Aquilegia chrysantha*	Native
OBL	*Veronica anagallis-aquatica*	Native	FAC	*Baccharis salicifolia*	Native
OBL	*Veronica peregrina subsp. xalapensis*	Native	FAC	*Bidens leptocephala*	Native
OBL	*Zannichellia palustris*	Native	FAC	*Celtis reticulata*	Native
FACW	*Acer negundo*	Native	FAC	*Chloracantha spinosa*	Native
FACW	*Adiantum capillus-veneris*	Native	FAC	*Claytonia perfoliata*	Native
FACW	*Agrostis stolonifera*	Non-Native	FAC	*Clematis ligusticifolia*	Native
FACW	*Alnus oblongifolia*	Native	FAC	*Cyperus fendlerianus*	Native
FACW	*Amaranthus blitoides*	Non-Native			

Rank	Scientific Name	Native/Int	Rank	Scientific Name	Native/Int
FAC	*Distichlis spicata*	Native	FAC	*Sporobolus airoides*	Native
FAC	*Eclipta prostrata*	Native	FAC	*Tamarix chinensis*	Non-Native
FAC	*Elaeagnus angustifolia*	Non-Native	FAC	*Thalictrum fendleri*	Native
FAC	*Elymus canadensis*	Native	FAC	*Toxicodendron radicans*	Native
FAC	*Equisetum arvense*	Native	FAC	*Trianthema portulacastrum*	Native
FAC	*Eragrostis pectinacea var. miserrima*	Native	FAC	*Tridens muticus*	Native
FAC	*Eragrostis pectinacea var. pectinacea*	Native	FAC	*Urtica dioica subsp. gracilis*	Native
FAC	*Euphorbia spathulata*	Native	FAC	*Verbena bracteata*	Native
FAC	*Fraxinus velutina*	Native	FAC	*Xanthium strumarium*	Native
FAC	*Glycyrrhiza lepidota*	Native	FAC	*Zuloagaea bulbosa*	Native
FAC	*Helianthus ciliaris*	Native	FACU	*Amaranthus palmeri*	Native
FAC	*Hordeum arizonicum*	Native	FACU	*Amaranthus retroflexus*	Native
FAC	*Juglans major*	Native	FACU	*Chenopodium fremontii*	Native
FAC	*Kochia scoparia*	Non-Native	FACU	*Rhus aromatica*	Native
FAC	*Laennecia coulteri*	Native	FACU	*Asclepias subverticillata*	Native
FAC	*Leymus cinereus*	Native	FACU	*Funastrum cynanchoides subsp. cynanchoides*	Native
FAC	*Leymus triticoides*	Native	FACU	*Funastrum cynanchoides subsp. hartwegii*	Native
FAC	*Lotus corniculatus*	Non-Native	FACU	*Dichelostemma capitatum*	Native
FAC	*Medicago lupulina*	Non-Native	FACU	*Achillea millefolium*	Native
FAC	*Mimulus rubellus*	Native	FACU	*Ambrosia psilostachya*	Native
FAC	*Mollugo cerviana*	Non-Native	FACU	*Artemisia ludoviciana*	Native
FAC	*Morus alba*	Non-Native	FACU	*Baccharis sarothroides*	Native
FAC	*Muhlenbergia rigens*	Native	FACU	*Baccharis wrightii*	Native
FAC	*Myosurus cupulatus*	Native	FACU	*Brickellia californica*	Native
FAC	*Oenothera flava*	Native	FACU	*Conyza canadensis*	Native
FAC	*Parthenocissus quinquefolia*	Native	FACU	*Coreopsis tinctoria*	Native
FAC	*Parthenocissus vitacea*	Native	FACU	*Helianthus annuus*	Native
FAC	*Pascopyrum smithii*	Native	FACU	*Pseudognaphalium canescens*	Native
FAC	*Paspalum dilatatum*	Non-Native	FACU	*Verbesina encelioides*	Native
FAC	*Phyla cuneifolia*	Native	FACU	*Chilopsis linearis*	Native
FAC	*Plantago lanceolata*	Non-Native	FACU	*Heliotropium curassavicum*	Native
FAC	*Plantago major*	Non-Native	FACU	*Plagiobothrys tenellus*	Native
FAC	*Poa pratensis*	Non-Native	FACU	*Lepidium virginicum*	Native
FAC	*Portulaca halimoides*	Native	FACU	*Peritoma jonesii*	Native
FAC	*Portulaca oleracea*	Non-Native	FACU	*Peritoma serrulata*	Native
FAC	*Pseudognaphalium luteoalbum*	Non-Native	FACU	*Polanisia dodecandra*	Native
FAC	*Ribes aureum*	Native	FACU	*Tradescantia occidentalis*	Native
FAC	*Rumex crispus*	Non-Native	FACU	*Convolvulus equitans*	Native
FAC	*Setaria pumila*	Non-Native	FACU	*Euphorbia hyssopifolia*	Native
FAC	*Solanum douglasii*	Native	FACU	*Euphorbia prostrata*	Native
FAC	*Sonchus asper*	Non-Native	FACU	*Acacia greggii*	Native
FAC	*Sporobolus airoides*	Native	FACU	*Dracocephalum parviflorum*	Native
FAC	*Tamarix chinensis*	Non-Native	FACU	*Mollugo verticillata*	Native
FAC	*Thalictrum fendleri*	Native	FACU	*Morus microphylla*	Native
FAC	*Toxicodendron radicans*	Native	FACU	*Boerhavia erecta*	Native
FAC	*Trianthema portulacastrum*	Native	FACU	*Forestiera pubescens*	Native
FAC	*Tridens muticus*	Native	FACU	*Oenothera curtiflora*	Native
FAC	*Urtica dioica subsp. gracilis*	Native	FACU	*Chloris virgata*	Native
FAC	*Verbena bracteata*	Native	FACU	*Elymus elymoides*	Native
FAC	*Xanthium strumarium*	Native	FACU	*Elymus glaucus*	Native
FAC	*Zuloagaea bulbosa*	Native	FACU	*Elymus trachycaulus subsp. trachycaulus*	Native
FAC	*Parthenocissus quinquefolia*	Native	FACU	*Eragrostis mexicana*	Native
FAC	*Parthenocissus vitacea*	Native	FACU	*Hopia obtusa*	Native
FAC	*Pascopyrum smithii*	Native	FACU	*Hordeum pusillum*	Native
FAC	*Paspalum dilatatum*	Non-Native	FACU	*Sporobolus cryptandrus*	Native
FAC	*Phyla cuneifolia*	Native	FACU	*Portulaca umbraticola*	Native
FAC	*Plantago lanceolata*	Non-Native	FACU	*Androsace occidentalis*	Native
FAC	*Plantago major*	Non-Native	FACU	*Amelanchier utahensis*	Native
FAC	*Poa pratensis*	Non-Native	FACU	*Rosa woodsii*	Native
FAC	*Portulaca halimoides*	Native	FACU	*Galium aparine*	Native
FAC	*Portulaca oleracea*	Non-Native	FACU	*Galium microphyllum*	Native
FAC	*Pseudognaphalium luteoalbum*	Non-Native	FACU	*Sapindus saponaria*	Native
FAC	*Ribes aureum*	Native	FACU	*Nicotiana obtusifolia*	Native
FAC	*Rumex crispus*	Non-Native	FACU	*Solanum americanum*	Native
FAC	*Setaria pumila*	Non-Native	FACU	*Parietaria hespera*	Native
FAC	*Solanum douglasii*	Native	FACU	*Vitis arizonica*	Native
FAC	*Sonchus asper*	Non-Native	FACU	*Amaranthus albus*	Non-Native

Rank	Scientific Name	Native/Int	Rank	Scientific Name	Native/Int
FACU	*Chenopodium murale*	Non-Native	FACU	*Trifolium repens*	Non-Native
FACU	*Chenopodium album*	Non-Native	FACU	*Marrubium vulgare*	Non-Native
FACU	*Salsola tragus*	Non-Native	FACU	*Bromus japonicus*	Non-Native
FACU	*Asparagus officinalis*	Non-Native	FACU	*Cynodon dactylon*	Non-Native
FACU	*Cirsium vulgare*	Non-Native	FACU	*Festuca arundinacea*	Non-Native
FACU	*Lactuca serriola*	Non-Native	FACU	*Hordeum murinum*	Non-Native
FACU	*Taraxacum officinale*	Non-Native	FACU	*Lolium pratense*	Non-Native
FACU	*Xanthium spinosum*	Non-Native	FACU	*Poa compressa*	Non-Native
FACU	*Capsella bursa-pastoris*	Non-Native	FACU	*Setaria verticillata*	Non-Native
FACU	*Sisymbrium altissimum*	Non-Native	FACU	*Sorghum bicolor*	Non-Native
FACU	*Ipomoea hederacea*	Non-Native	FACU	*Sorghum halepense*	Non-Native
FACU	*Melilotus alba*	Non-Native	FACU	*Rubus discolor*	Non-Native
FACU	*Melilotus officinalis*	Non-Native	FACU	*Verbascum thapsus*	Non-Native
FACU	*Trifolium fragiferum*	Non-Native			

APPENDIX C

ANNOTATED CHECKLIST FOR THE UPPER VERDE RIVER

The annotated checklist is in alphabetical order by family, genus and species. Family nomenclature follows APG III (http://www.mobot.org/MOBOT/research/APweb/), Scientific Name, Author and Synonyms are from Tropicos (http://www.tropicos.org/), The Plant List (http://www.theplantlist.org/), and advice from specialists. Common Name, Native Status, Duration, and Life Form were obtained from the USDA Plants Database (http://plants.usda.gov/). Wetland Status was obtained from the US Army Corps of Engineers Wetland Indicator List (Lichvar et al. 2014). Collector last name and number are included for at least one voucher of each species in the Flora.

Definitions of categories are in Appendix A. The following are explanations for abbreviations. Native Status: I = Introduced and N = Native. Duration: Ann = Annual, Per = Perennial, and Bien = Biennial. Lifeform: Gram = Graminoid and Succ = Succulent.

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ADOXACEAE	*Sambucus cerulea*	Raf.	blue elderberry	N	Per	Shrub		Coburn 1767	*Sambucus nigra subsp. cerulea, Sambucus neomexicana*
AIZOACEAE	*Trianthema portulacastrum*	L.	desert horsepurslane	N	Ann	Herb	FAC	Coburn 1058	
ALISMATACEAE	*Alisma triviale*	Pursh	northern water plantain	N	Per	Herb	OBL	Coburn 1782	*Alisma brevipes, Alisma plantago-aquatica subsp. brevipes, Alisma plantago-aquatica*
AMARANTHACEAE	*Amaranthus albus*	L.	prostrate pigweed	I	Ann	Herb	FACU	Coburn 749	*Amaranthus albus var. pubescens,Amaranthus pubescens*
AMARANTHACEAE	*Amaranthus blitoides*	S. Wats.	mat amaranth	I	Ann	Herb	FACW	Coburn 431, 280	*Amaranthus graecizans*
AMARANTHACEAE	*Amaranthus crassipes*	Schlecht.	Clubfoot amaranth	I	Ann	Herb	FAC	Coburn 1334	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
AMARANTHACEAE	*Amaranthus fimbriatus*	(Torr.) Benth. ex S. Wats.	fringed amaranth	N	Ann	Herb	UPL	Coburn 1134	
AMARANTHACEAE	*Amaranthus palmeri*	S. Wats.	Palmer's amaranth	N	Ann	Herb	FACU	Coburn 1333, Coburn 848	
AMARANTHACEAE	*Amaranthus powellii*	S. Wats.	Powell's amaranth	N	Ann	Herb	UPL	Coburn 1353	*Amaranthus bracteosus, Amaranthus retroflexus var. powellii, Amaranthus viscidulus*
AMARANTHACEAE	*Amaranthus retroflexus*	L.	redroot amaranth	N	Ann	Herb	FACU	Coburn 1352	*Amaranthus retroflexus var. salicifolius*
AMARANTHACEAE	*Amaranthus torreyi*	(A. Gray) Benth. ex S. Wats.	Torrey's amaranthus	N	Ann	Herb	UPL	Coburn 1258, Coburn 1818	*Amaranthus pringlei*
AMARANTHACEAE	*Atriplex canescens*	(Pursh) Nutt.	fourwing saltbush	N	Per	Shrub	UPL	Coburn 1526, Coburn 676	
AMARANTHACEAE	*Atriplex elegans*	(Moq.) D. Dietr.	wheelscale saltbush	N	Ann	Herb	UPL	Coburn 1244	
AMARANTHACEAE	*Atriplex patula*	Sm.	spear saltbush	I	Ann	Herb		Coburn 960, Coburn 411	*Atriplex patula var. bracteata, Atriplex patula var. japonica*
AMARANTHACEAE	*Atriplex wrightii*	S. Wats.	Wright's saltbush	N	Ann	Herb	UPL	Coburn 1059, Coburn 959	
AMARANTHACEAE	*Chenopodiastrum murale*	(L.) S. Fuentes, Uotila & Borsch	nettleleaf goosefoot	I	Ann	Herb	FACU	Rink 74438	*Chenopodium murale*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
AMARANTHACEAE	*Chenopodium album*	L.	lambsquarters	I	Ann	Herb	FACU	Coburn 1187, Coburn 1188	*Chenopodium giganteum*
AMARANTHACEAE	*Chenopodium berlandieri*	Moq.	pitseed goosefoot	N	Ann	Herb		Coburn 1352b	
AMARANTHACEAE	*Chenopodium fremontii*	S. Wats.	Fremont's goosefoot	N	Ann	Herb	FACU	Coburn 1485, Coburn 371	
AMARANTHACEAE	*Chenopodium incanum*	(S. Wats.) Heller	mealy goosefoot	N	Ann	Herb		Demeree 42472	
AMARANTHACEAE	*Chenopodium neomexicanum*	Standl.	New Mexico goosefoot	N	Ann	Herb		Coburn 121, Coburn 1130	
AMARANTHACEAE	*Chenopodium pratericola*	Rydb.	desert goosefoot	N	Ann	Herb		Baker 9795	*Chenopodium albescens*
AMARANTHACEAE	*Corispermum americanum*	(Nutt.) Nutt.	American bugseed	N	Ann	Herb		Hazelton 359	*Corispermum nitidum*
AMARANTHACEAE	*Dysphania graveolens*	(Willdenow) Mosyakin & Clemants	fetid goosefoot	N	Ann	Herb	UPL	Coburn 1817	*Chenopodium graveolens, Teloxys graveolens*
AMARANTHACEAE	*Gomphrena caespitosa*	Torr.	tufted globe amaranth	N	Per	Herb		Coburn 1692	
AMARANTHACEAE	*Kochia scoparia*	(L.) Schrad.	Mexican-fireweed	I	Ann	Herb	FAC	Coburn 1481, Coburn 1961	*Bassia scoparia*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
AMARANTHACEAE	*Krascheninnikovia lanata*	(Pursh) A.D.J. Meeuse & Smit	winterfat	N	Per	Shrub		Coburn 1943, Coburn 1348	*Ceratoides lanata, Eurotia lanata*
AMARANTHACEAE	*Salsola tragus*	L.	prickly Russian thistle	I	Ann	Herb	FACU	Coburn 916	*Salsola australis, S. iberica, S. kali subsp. tragus*
ANACARDIACEAE	*Rhus aromatica*	Ait.	fragrant sumac	N	Per	Shrub	FACU	Coburn 801, Coburn 705	
ANACARDIACEAE	*Toxicodendron radicans*	(L.) Kuntze	eastern poison ivy	N	Per	Shrub	FAC	Coburn 789, Coburn 878	
APIACEAE	*Berula erecta*	(Huds.) Coville	cutleaf waterparsnip	N	Per	Herb	OBL	Coburn 327b, Coburn 951	*Berula erecta var. incisa, Berula incisa, Berula pusilla, Siella erecta*
APIACEAE	*Cymopterus multinervatus*	(Coult. & Rose) Tidestrom	purplenerve springparsley	N	Per	Herb		Coburn 473, Coburn 502	
APIACEAE	*Daucus pusillus*	Michx.	American wild carrot	N	Ann	Herb		Coburn 58, Coburn 546	
APIACEAE	*Lomatium foeniculaceum subsp. macdougalii*	(Coult. & Rose) Theobald	Macdougal's biscuitroot	N	Per	Herb		Coburn 533	*Lomatium foeniculaceum var. macdougalii*
APIACEAE	*Lomatium nevadense*	(S. Wats.) Coult. & Rose	Nevada biscuitroot	N	Per	Herb		Coburn 590	
APIACEAE	*Torilis arvensis*	(Huds.) Link	spreading hedgeparsley	I	Ann	Herb		Coburn 792, Coburn 1743	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
APOCYNACEAE	*Amsonia palmeri*	A. Gray	Palmer's bluestar	N	Per	Herb		Coburn 578, Coburn 155	*Amsonia hirtella, Amsonia pogonosepala, Amsonia standleyi*
APOCYNACEAE	*Apocynum cannabinum*	L.	Indianhemp	N	Per	Herb	FAC	Coburn 706, Coburn 1731	*Apocynum hypericifolium, A. pubescens, A. sibiricum, A. suskdorfii*
APOCYNACEAE	*Asclepias asperula*	(Dcne.) Woods.	spider milkweed	N	Per	Herb	None	Coburn 561, Coburn 607	*Acerates asperula, Asclepiodora asperula*
APOCYNACEAE	*Asclepias involucrata*	Engelm. ex Torr.	dwarf milkweed	N	Per	Herb	None	Coburn 1705, Coburn 614	*Asclepias macrosperma*
APOCYNACEAE	*Asclepias latifolia*	(Torr.) Raf.	broadleaf milkweed	N	Per	Herb	None		*Aclepias jamesii, Asclepias obtusifolia var. latifolia*
APOCYNACEAE	*Asclepias nyctaginifolia*	A. Gray	Mojave milkweed, four o'clock milkweed	N	Per	Herb	None	Coburn 932, Coburn 966	
APOCYNACEAE	*Asclepias subverticillata*	(A. Gray) Vail	horsetail milkweed	N	Per	Herb	FACU	Coburn 334b, Coburn 1744	*Asclepias galioides*
APOCYNACEAE	*Funastrum crispum*	(Benth.) Schltr.	wavyleaf twinevine	N	Per	Vine		Coburn 722	*Sarcostemma crispum, Sarcostemma lobata, Sarcostemma cynanchoides subsp. Crispum*
APOCYNACEAE	*Funastrum cynanchoides subsp. cynanchoides*	(Decne.) Schltr.	fringed twinevine	N	Per	Vine	FACU	Coburn 855	*Sarcostemma cynanchoides subsp. cynanchoides*
APOCYNACEAE	*Funastrum cynanchoides subsp. hartwegii*	(Vail) Krings	Southern Twinevine	N	Per	Vine	FACU	Coburn 378	*Funastrum cynanchoides var. subtruncatum, Sarcostemma cynanchoides subsp. hartwegii*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
APOCYNACEAE	*Matelea producta*	(Torr.) Woods.	Texas milkvine	N	Per	Vine		Coburn 856	*Gonolobus productus*
APOCYNACEAE	*Vinca major*	L.	bigleaf periwinkle	I	Per	Herb/ Vine		I'll take care of this	*Vinca major var. variegata*
ARACEAE	*Lemna gibba*	L.	swollen duckweed	N	Per	Herb	OBL	Baker 12639	
ARACEAE	*Lemna valdiviana*	Phil.	valdivia duckweed	N	Per	Herb	OBL	Baker 12648	*Lemna cyclostasa, Lemna torreyi*
ARALIACEAE	*Hydrocotyle verticillata*	Thunb.	whorled marshpennywort	N	Per	Herb	OBL	Coburn 896	
ASPARAGACEAE	*Agave delamateri*	W.C. Hodgson & L. Slauson	Tonto Basin century plant	N	Per	Succ		Hodgson 17249	
ASPARAGACEAE	*Agave parryi*	Engelm.	Parry's agave	N	Per	Succ		Coburn 1173	
ASPARAGACEAE	*Agave phillipsiana*	W.C.Hodgs.	Grand Canyon century plant	N	Per	Succ	None	Hodgson 26540, 26541	
ASPARAGACEAE	*Androstephium breviflorum*	S. Wats.	pink funnel lily	N	Per	Herb		Coburn 1575A	
ASPARAGACEAE	*Asparagus officinalis*	L.	garden asparagus	I	Per	Herb	FACU	Coburn 1748	
ASPARAGACEAE	*Dichelostemma capitatum*	(Benth.) Wood	bluedicks	N	Per	Herb	FACU	Coburn 1573B, Coburn 550	*Brodiaea capitata, Dichelostemma pulchellum var. capitatum, Dipterostemon*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
									capitatus, Milla capitata
ASPARAGACEAE	*Nolina microcarpa*	S. Wats.	sacahuista	N	Per	Shrub		Coburn 324	
ASPARAGACEAE	*Yucca angustissima*	Engelm. ex Trel.	palmilla	N	Per	Succ	None	Coburn 649	
ASPARAGACEAE	*Yucca baccata*	Torr.	banana yucca	N	Per	Succ		Baker 8924	
ASPARAGACEAE	*Yucca elata var. verdiensis*	(McKelvey) Reveal	Verde yucca	N	Per	Succ		Hodgson 17419	*Yucca verdiensis*
ASTERACEAE	*Achillea millefolium*	L.	common yarrow	N	Per	Herb	FACU	Coburn 809b	*Achillea alpicola, Achillea fusca, Achillea lanulosa subsp. alpicolaAchillea subalpina, Achillea angustissima,*
ASTERACEAE	*Acourtia nana*	(A. Gray) Reveal & King	dwarf desertpeony	N	Per	Herb		Coburn 1557	*Perezia nana*
ASTERACEAE	*Acourtia wrightii*	(A. Gray) Reveal & King	brownfoot	N	Per	Herb		Coburn 290, Coburn 736	*Perezia wrightii*
ASTERACEAE	*Adenophyllum porophylloides*	(A. Gray) Strother	San Felipe dogweed	N	Per	Subshrub		Coburn 1934	*Dyssodia porophylloides*
ASTERACEAE	*Ageratina herbacea*	(A. Gray) King & H.E. Robins.	fragrant snakeroot	N	Ann	Subshrub		Coburn 1310, Coburn 1427	*Eupatorium herbaceum*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Amauriopsis dissecta*	Rydb.	ragleaf bahia	N	Per	Herb		Coburn 1250, Coburn 1375	*Bahia dissecta, Amauria dissecta*
ASTERACEAE	*Ambrosia acanthicarpa*	Hook.	flatspine bur ragweed	N	Ann	Herb		Coburn 1960	*Franseria acanthicarpa*
ASTERACEAE	*Ambrosia confertiflora*	Dc.	weakleaf bur ragweed	N	Per	Herb		Baker 11967	*Franseria convertiflora, F. strigulosa, Gaertneria tenuifolia*
ASTERACEAE	*Ambrosia monogyra*	(Torr. & A. Gray) Strother & B.G.Baldwin	singlewhorl burrobrush	N	Per	Shrub	UPL	Coburn 1536	*Hymenoclea monogyra*
ASTERACEAE	*Ambrosia psilostachya*	DC.	Cuman ragweed	N	Per	Herb	FACU	Coburn 990, Coburn 410	*Ambrosia californica, A. coronopifolia, A. cumanensis*
ASTERACEAE	*Ambrosia trifida*	L.	great ragweed	N	Ann	Herb	FAC	Coburn 1079	*Ambrosia aptera*
ASTERACEAE	*Artemisia campestris*	L.	field sagewort	N	Per	Herb	UPL	Coburn 829, Coburn 1377	*Artemisia campestris subsp. campestris, Artemisia caudata, Oligosporus campestris*
ASTERACEAE	*Artemisia dracunculus*	L.	tarragon	N	Per	Subshrub		Coburn 419, Coburn 1433	*Artemisia dracunculoides, Artemisia dracunculoides var. dracunculina, Artemisia glauca*
ASTERACEAE	*Artemisia ludoviciana*	Nutt.	white sagebrush	N	Per	Herb	FACU	Coburn 406	
ASTERACEAE	*Baccharis brachyphylla*	A. Gray	shortleaf baccharis	N	Per	Subshrub		Coburn 1431b, Coburn 453	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Baccharis pteronioides*	Dc.	yerba de pasmo	N	Per	Shrub		Coburn 232, Coburn 296	
ASTERACEAE	*Baccharis salicifolia*	(Ruiz & Pav.) Pers.	mule-fat	N	Per	Shrub	FAC	Coburn 80, Coburn 326b	*Baccharis glutinosa, B. viminea, Molina salicifolia*
ASTERACEAE	*Baccharis sarothroides*	A. Gray	desertbroom	N	Per	Shrub	FACU	Coburn 1470, Coburn 439	
ASTERACEAE	*Baccharis wrightii*	A. Gray	Wright's baccharis	N	Per	Subshrub	FACU	Coburn 679	
ASTERACEAE	*Baileya multiradiata*	Harvey & A. Gray ex A. Gray	desert marigold	N	Per	Herb		Coburn 1025, Coburn 329a	
ASTERACEAE	*Bidens aurea*	(Ait.) Sherff	Arizona beggarticks	N	Per	Herb	OBL	Coburn 1478	*Bidens aurea var. wrightii, Bidens heterophylla, Coreopsis aurea*
ASTERACEAE	*Bidens laevis*	(L.) B.S.P.	smooth beggartick	N	Ann	Herb	OBL	Coburn 455	*Bidens elegans, Bidens nashii, Helianthus laevis*
ASTERACEAE	*Bidens leptocephala*	Sherff	fewflower beggarticks	N	Ann	Herb	FAC	Coburn 1373, Coburn 1124b	
ASTERACEAE	*Brickellia atractyloides*	A. Gray	spearleaf brickellbush	N	Per	Subshrub		Coburn 1072, Coburn 136	
ASTERACEAE	*Brickellia californica*	(Torr. & A. Gray) A. Gray	California brickellbush	N	Per	Subshrub	FACU	Coburn 1502, Coburn 415	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Brickellia eupatorioides var. chlorolepis*	(Woot. & Standl.) B.L. Turner	false boneset	N	Per	Subshrub		Coburn 1493, Coburn 1356	*Brickellia chlorolepis, B. leptophylla var. mexicana*
ASTERACEAE	*Brickellia floribunda*	A. Gray	Chihuahuan brickellbush	N	Per	Subshrub		Coburn 408, Coburn 1541	
ASTERACEAE	*Brickellia microphylla var. scabra*	A. Gray	rough brickellbush	N	Per	Shrub		Coburn 409	*Brickellia microphylla ssp. scabra, Brickellia scabra*
ASTERACEAE	*Centaurea melitensis*	L.	Maltese star-thistle	I	Ann	Herb		Coburn 281, Coburn 81	
ASTERACEAE	*Chaetopappa ericoides*	(Torr.) G.L. Nesom	rose heath	N	Per	Herb		Coburn 548, Coburn 184	*Aster arenosus, A. hirtifolius, A. leucelene, Inula ericoides, Leucelene ericoides*
ASTERACEAE	*Chloracantha spinosa*	(Benth.) G.L. Nesom	spiny chloracantha	N	Per	Subshrub	FAC	Coburn 442, Coburn 1497	*Aster spinosus, Erigeron ortegae, Leucosyris spinosa*
ASTERACEAE	*Cirsium neomexicanum*	A. Gray	New Mexico thistle	N	Per	Herb		Coburn 285, Coburn 1642	
ASTERACEAE	*Cirsium ochrocentrum*	A. Gray	yellowspine thistle	N	Per	Herb		Coburn 1524b	*Cnicus ochrocentrus*
ASTERACEAE	*Cirsium vulgare*	(Savi) Ten.	bull thistle	I	Bien	Herb	FACU	Coburn 1009	*Carduus lanceolatus, Carduus vulgaris, Cirsium lanceolatum*
ASTERACEAE	*Cirsium wheeleri*	(A. Gray) Petrak	Wheeler's thistle	N	Per	Herb	UPL	Coburn 1138	*Cirsium blumeri, Cirsium perennans, Cirsium wheeleri var. salinense, Cnicus wheeleri*
ASTERACEAE	*Conyza canadensis*	(L.) Cronq.	Canadian horseweed	N	Ann	Herb	FACU	Coburn 1573, Coburn 347	*Conyza canadensis var. glabrata, Erigeron canadensis var. glabratus*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Coreopsis tinctoria*	Nutt.	golden tickseed	N	Ann	Herb	FACU	Coburn 995, Coburn 271	*Several, see Tropicos*
ASTERACEAE	*Dieteria asteroides var. asteroides*		fall tansyaster	N	Per	Herb		Coburn 1436, Coburn 426	*Aster canescens var. tephrodes, Aster tephrodes, Machaerantera tephrodes*
ASTERACEAE	*Dieteria asteroides var. glandulosa*	(B.L. Turner) D.R. Morgan & R.L. Hartman	fall tansyaster	N	Per	Herb		Coburn 1398	*Machaeranthera asteroides var. glandulosa*
ASTERACEAE	*Eclipta prostrata*	(L.) L.	false daisy	N	Ann	Herb	FAC	Coburn 1466, Coburn 342b	*Eclipta alba, Eclipta punctata, Verbesina alba, Verbesina prostrata*
ASTERACEAE	*Encelia virginensis*	A. Nels.	Virgin River brittlebush	N	Per	Shrub		Coburn 1200, Coburn 1940, Coburn 1224	*Encelia frutescens var. virginensis, Encelia virginensis var. virginensis*
ASTERACEAE	*Ericameria linearifolia*	(DC.) Urbatsch & Wussow	narrowleaf goldenbush	N	Per	Shrub		Coburn 1570, Coburn 1702	*Happlopappus linearifolius, Haplopappus linearifolius ssp. Interior*
ASTERACEAE	*Ericameria nauseosa var. oreophila*	(A. Nels.) G.L. Nesom & Baird	rubber rabbitbrush	N	Per	Shrub		Coburn 1524	*Ericameria nauseosa subsp. consimilis, Chrysothamnus nauseosus subsp. consimilis*
ASTERACEAE	*Erigeron accedens*	Greene		N	Per	Herb		Coburn 209, 1657	
ASTERACEAE	*Erigeron concinnus*	(Hook. & Arn.) Torr. & A. Gray	Navajo fleabane	N	Per	Herb		Coburn 562, Coburn 1452	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Erigeron divergens*	Torr. & A. Gray	spreading fleabane	N	Bien	Herb		Coburn 75, Coburn 1491	*Erigeron divergens var. typicus*
ASTERACEAE	*Erigeron neomexicanus*	A. Gray	New Mexico fleabane	N	Per	Herb		Coburn 1657	*Erigeron delphiniifolius subsp. neomexicanus, Erigeron delphiniifolius var. euneomexicanus*
ASTERACEAE	*Erigeron oreophilus*	Greenm.	chaparral fleabane	N	Per	Herb		Coburn 1374, Coburn 1512	*Erigeron delphiniifolius var. oreophilus*
ASTERACEAE	*Erigeron tracyi*	Greene	running fleabane	N	Bien	Herb		Coburn 1740, Coburn 980	*Erigeron divergens var. cinereus, Erigeron colomexicanus*
ASTERACEAE	*Euthamia occidentalis*	Nutt.	western goldentop	N	Per	Herb	FACW	Coburn 1533	*Euthamia californica, Euthamia linearifolia., Solidago occidentalis*
ASTERACEAE	*Gaillardia pinnatifida*	Torr.	red dome blanketflower	N	Per	Herb		Coburn 1437, Coburn 95	*Gaillardia flava*
ASTERACEAE	*Gnaphalium palustre*	Nutt.	western marsh cudweed	N	Ann	Herb	FACW	Coburn 747	*Filaginella palustris*
ASTERACEAE	*Grindelia squarrosa*	(Pursh) Dunal	curlytop gumweed	N	Ann/ Bien/Per	Herb		Coburn 832, Coburn 1353b	*Grindelia nuda*
ASTERACEAE	*Gutierrezia sarothrae*	(Pursh) Britt. & Rusby	broom snakeweed	N	Per	Subshrub		Coburn 1517, Coburn 933	*Gutierrezia diversifolia, G. lepidota, G. linearifolia, Solidago sarothrae, Xanthocephalum sarothrae*
ASTERACEAE	*Helianthus annuus*	L.	common sunflower	N	Ann	Herb	FACU	Coburn 1345, Coburn 313	*Helenium aridus, H. lenticularis*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
ASTERACEAE	*Helianthus ciliaris*	Dc.	Texas blueweed	N	Per	Herb	FAC	Coburn 162b	
ASTERACEAE	*Helianthus petiolaris*	Nutt.	prairie sunflower	N	Ann	Herb		Coburn 1346	
ASTERACEAE	*Heliomeris longifolia var. annua*	(M.E. Jones) Yates	longleaf false goldeneye	N	Ann	Herb		Coburn 1344, Coburn 1510	*Viguiera annua, Gymnolomia multiflora var. annua*
ASTERACEAE	*Heliomeris multiflora var. nevadensis*	(A. Nels.) Yates	Nevada goldeneye	N	Per	Herb		Coburn 441	*Gymnolomia nevadensis*
ASTERACEAE	*Heterotheca fulcrata*	(Greene) Shinners	goldenaster	N	Per	Herb/Sub		Coburn 1486, Coburn 1085	
ASTERACEAE	*Heterotheca subaxillaris*	(Lam.) Britt. & Rusby	camphorweed	N	Ann	Herb		Coburn 953, Coburn 336b	*Heterotheca psammophila, Chrysopsis scabra, Heterotheca lamarckii, H. latifolia, H. scabra*
ASTERACEAE	*Heterotheca villosa*	(Pursh) Shinners	hairy false goldenaster	N	Per	Herb		Coburn 1419	
ASTERACEAE	*Heterotheca zionensis*	Semple	Zion false goldenaster	N	Per	Herb		Coburn 395	
ASTERACEAE	*Hymenopappus filifolius var. lugens*	(Greene) Jepson	fineleaf hymenopappus	N	Per	Herb		Coburn 784	*Hymenopappus lugens*
ASTERACEAE	*Hymenothrix loomisii*	Blake	Loomis' thimblehead	N	Ann	Herb		Coburn 1442, Coburn 350	

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ASTERACEAE	*Hymenothrix wrightii*	A. Gray	Wright's thimblehead	N	Per	Herb		Coburn 447, Coburn 1379	
ASTERACEAE	*Hymenoxys cooperi*	(A. Gray) Cockerell	Cooper's rubberweed	N	Ann / Bien/ Per	Herb		Coburn 577, Coburn 1773	
ASTERACEAE	*Lactuca serriola*	L.	prickly lettuce	I	Ann	Herb	FACU	Coburn 884, Coburn 693	*Linnaeus scariola*
ASTERACEAE	*Laennecia coulteri*	(A. Gray) G.L. Nesom	Coulter's horseweed	N	Ann	Herb	FAC	Coburn 366	*Conyza coulteri*
ASTERACEAE	*Layia glandulosa*	(Hook.) Hook. & Arn.	whitedaisy tidytips	N	Ann	Herb		Coburn 625, Coburn 36	*Layia glandulosa subsp. lutea*
ASTERACEAE	*Logfia filaginoides*	(Hook. & Arn.) Morefield	California cottonrose	N	Ann	Herb		Coburn 1560, Coburn 1598	*Gnaphalium filaginoides, Logfia californica*
ASTERACEAE	*Machaeranthera tagetina*	Greene	mesa tansyaster	N	Ann	Herb		Coburn 1287, Coburn 358	*Aster tagetinus*
ASTERACEAE	*Malacothrix clevelandii*	A. Gray	Cleveland's desertdandelion	N	Ann	Herb		Coburn 1724	
ASTERACEAE	*Melampodium leucanthum*	Torr. & A. Gray	plains blackfoot	N	Per	Subshrub		Coburn 1234, Coburn 237	
ASTERACEAE	*Onopordum acanthium*	L.	Scotch cottonthistle	I	Bien	Forb		Demaree 45592, Coburn 772	
ASTERACEAE	*Packera multilobata*	(Torr. & A. Gray ex A.	lobeleaf groundsel	N	Per	Herb		Coburn 107 b, Coburn 1726	*Senecio lynceus, Senecio multilobatus, Senecio stygius, Senecio thornberi*

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ASTERACEAE	*Packera quercetorum*	Gray) W.A. Weber & A. LÃ¶ve (Greene) C. Jeffrey	Oak Creek ragwort	N	Per	Herb		Baker 11778	*Senecio quercetorum*
ASTERACEAE	*Parthenium incanum*	Kunth	mariola	N	Per	Shrub		Coburn 1429, Coburn 452	
ASTERACEAE	*Pectis prostrata*	Cav.	spreading chinchweed	N	Ann	Herb		Coburn 1907, Coburn 1084	*Pectis multisetosa, P. prostrata var. urceolata*
ASTERACEAE	*Pectis rusbyi*	Greene ex A. Gray	Rusby's chinchweed	N	Ann	Herb		Coburn 1203, Coburn 976	
ASTERACEAE	*Perityle ciliata*	(L.H. Dewey) Rydb.	fringed rockdaisy	N	Per	Subshrub		Coburn 359, Coburn 1055	
ASTERACEAE	*Porophyllum gracile*	Benth.	slender poreleaf	N	Per	Subshrub		Coburn 1122	*Porophyllum caesium, Porophyllum junciforme, Porophyllum nodosum, Porophyllum putidum*
ASTERACEAE	*Pseudognaphalium canescens*	(DC.) Anderb.	Wright's cudweed	N	Per	Herb	FACU	Coburn 863, Coburn 1540	*Gnaphalium canescens, G. texanum*
ASTERACEAE	*Pseudognaphalium luteoalbum*	(L.) Hilliard & Burtt	Jersey cudweed	I	Ann	Herb	FAC	Coburn 205, Coburn 993	*Gnaphalium luteoalbum, Laphingium luteoalbum*
ASTERACEAE	*Rhaponticum repens*	(L.) Hidalgo	hardheads	I	Per	Herb		Coburn 770, Coburn 217	*Acroptilon repens, Centaurea picris, Centaurea repens*

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ASTERACEAE	*Sanvitalia abertii*	A. Gray	Albert's creeping zinnia	N	Ann	Herb		Coburn 1444, Coburn 461	
ASTERACEAE	*Senecio eremophilus var. macdougalii*	(Heller) Cronq.	MacDougal's ragwort	N	Per	Subshrub		Baker 8987	*Senecio macdougalii*
ASTERACEAE	*Senecio flaccidus var. flaccidus*		threadleaf ragwort	N	Per	Subshrub		Coburn 352, Coburn 1492	*Senecio douglasii, S. filifolius, S. longilobus*
ASTERACEAE	*Senecio flaccidus var. monoensis*	(Greene) B.L. Turner & T.M. Barkl.	smooth threadleaf ragwort	N	Per	Subshrub		Coburn 68, Coburn 1542	*Several, see Tropicos*
ASTERACEAE	*Solidago missouriensis*	Nutt.	Missouri goldenrod	N	Per	Herb		Coburn 1408	
ASTERACEAE	*Solidago velutina*	Dc.	threenerve goldenrod	N	Per	Herb	UPL	Baker 9639	*Solidago arizonica, S. californica var. nevadensis, S. canadensis var. arizonica, S. sparsiflora*
ASTERACEAE	*Solidago wrightii*	A. Gray	Wright's goldenrod	N	Per	Herb		Coburn 370, Coburn 1438	*Solidago wrightii var. adenophora, Solidago bigelovii var. wrightii, Solidago bigelovii*
ASTERACEAE	*Sonchus asper*	(L.) Hill	spiny sowthistle	I	Ann	Herb	FAC	Coburn 804, Coburn 211	
ASTERACEAE	*Stephanomeria pauciflora*	(Torr.) A. Nels.	brownplume wirelettuce	N	Per	Subshrub		Coburn 1775, Coburn 304	*Stephanomeria cinera, S. neomexicana, S. pauciflora var. parishii*
ASTERACEAE	*Stephanomeria tenuifolia*	(Raf.) Hall	narrowleaf wirelettuce	N	Per	Herb		Coburn 726	*Stephanomeria minor, Ptiloria tenuifolia*

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ASTERACEAE	*Symphyotrichum expansum*	(Poepp. ex Spreng.) G.L.Nesom	southwestern annual saltmarsh aster	N	Ann / Bien	Herb	OBL	Coburn 992, Coburn 1522	*Aster subulatus, Symphyotrichum subulatum var. parviflorum*
ASTERACEAE	*Symphyotrichum lanceolatum var. hesperium*	(A. Gray) G.L. Nesom	white panicle aster	N	Per	Herb	OBL	Coburn 1532	
ASTERACEAE	*Taraxacum officinale*	G.H. Weber ex Wiggers	common dandelion	I	Per	Herb	FACU	Coburn 891, Coburn 988	*Many, see Tropicos*
ASTERACEAE	*Tetraneuris acaulis var. arizonica*	(Greene) Parker	Arizona four-nerve daisy	N	Per	Herb		Coburn 606, Coburn 983	*Hymenoxys acaulis var. nana, Tetraneuris acaulis var. nana*
ASTERACEAE	*Thymophylla acerosa*	(DC.) Strother	pricklyleaf dogweed	N	Per	Subshrub		Coburn 1235, Coburn 760	*Dyssodia acerosa*
ASTERACEAE	*Thymophylla pentachaeta*	(DC.) Small	fiveneedle pricklyleaf	N	Per	Subshrub		Rink 1863, Baker 11744	
ASTERACEAE	*Townsendia annua*	Beaman	annual Townsend daisy	N	Ann	Herb		Quinn 545	
ASTERACEAE	*Tragopogon dubius*	Scop.	yellow salsify	N	Ann/ Bien	Herb		Coburn 681, Coburn 248	*Tragopogon dubius subsp. major, Tragopogon major*
ASTERACEAE	*Uropappus lindleyi*	(DC.) Nutt.	Lindley's silverpuffs	N	Ann	Herb		Coburn 1645, Coburn 1680	*Microseris linearifolia, Uropappus lindleyi, Uropappus linearifolius*
ASTERACEAE	*Verbesina encelioides*	(Cav.) Benth. & Hook. f. ex A. Gray	golden crownbeard	N	Ann	Herb	FACU	Coburn 118, Coburn 1372	

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ASTERACEAE	*Viguiera dentata*	(Cav.) Spreng.	toothleaf goldeneye	N	Per	Herb		Coburn 1371, Coburn 1293	
ASTERACEAE	*Xanthisma gracile*	(Nutt.) D.R.Morgan & R.L.Hartm.	slender goldenweed	N	Ann	Herb		Coburn 91, Coburn 1011	*Machaeranthera gracilis, Dieteria gracilis, Haplopappus gracilis, Haplopappus ravenii*
ASTERACEAE	*Xanthium spinosum*	L.	spiny cocklebur	I	Ann	Herb	FACU	Coburn 308	
ASTERACEAE	*Xanthium strumarium*	L.	rough cocklebur	N	Ann	Herb	FAC	Coburn 311	*Xanthium acerosum, Xanthium californicum, Xanthium cenchroides*
ASTERACEAE	*Zinnia grandiflora*	Nutt.	Rocky Mountain zinnia	N	Per	Subshrub		Coburn 333a, Coburn 1121	*Crassina grandiflora*
BERBERIDACEAE	*Berberis fremontii*	Torr.	Fremont's mahonia	N	Per	Shrub		Coburn 1776	*Mahonia fremontii, Berberis higginsiae, Mahonia higginsiae, Odostemon fremontii*
BERBERIDACEAE	*Berberis haematocarpa*	Woot.	red barberry	N	Per	Shrub		Coburn 1777, Coburn 1763	*Mahonia haematocarpa*
BETULACEAE	*Alnus oblongifolia*	Torr.	Arizona alder	N	Per	Tree	FACW	Coburn 251	
BIGNONIACEAE	*Chilopsis linearis*	(Cav.) Sweet	desert willow	N	Per	Tree	FACU	Coburn 268	
BORAGINACEAE	*Amsinckia intermedia*	Fisch. & C.A. Mey.	common fiddleneck	N	Ann	Herb		Coburn 510, Coburn 94	*Amsinckia intermedia, Amsinckia intermedia var. echinata, several others: see Tropicos*

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BORAGINACEAE	*Cryptantha barbigera*	(A. Gray) Greene	bearded cryptantha	N	Ann	Herb		Coburn 27, Coburn 1688	
BORAGINACEAE	*Cryptantha cinerea*	(Greene) Cronq.	James' cryptantha	N	Per	Herb		Coburn 1695	
BORAGINACEAE	*Cryptantha circumscissa*	(Hook. & Arn.) I.M. Johnston	cushion cryptantha	N	Ann	Herb		Coburn 1683, Coburn 652	
BORAGINACEAE	*Cryptantha crassisepala*	(Torr. & A. Gray) Greene	thicksepal cryptantha	N	Ann	Herb		Coburn 1643	
BORAGINACEAE	*Cryptantha gracilis*	Osterhout	narrowstem cryptantha	N	Ann	Herb		Coburn 580, Coburn 1733	
BORAGINACEAE	*Cryptantha muricata*	(Hook. & Arn.) A. Nels. & J.F. Macbr.	pointed cryptantha	N	Ann	Herb		Coburn 1729	*Cryptantha muricata var. denticulata, Cryptantha muricata var. jonesii, Cryptantha muricata var. muricata*
BORAGINACEAE	*Cryptantha nevadensis*	A. Nels. & Kennedy	Nevada cryptantha	N	Ann	Herb		Coburn 1732, Coburn 1602	
BORAGINACEAE	*Cryptantha pterocarya*	(Torr.) Greene	wingnut cryptantha	N	Ann	Herb		Coburn 116, Coburn 1630	
BORAGINACEAE	*Eucrypta micrantha*	(Torr.) Heller	dainty desert hideseed	N	Ann	Herb		Coburn 1727, Coburn 120 b	
BORAGINACEAE	*Heliotropium curassavicum*	L.	salt heliotrope	N	Per	Herb	FACU	Coburn 402, Coburn 677	

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BORAGINACEAE	*Lappula occidentalis*	(S. Wats.) Greene	flatspine stickseed	N	Ann	Herb		Coburn 193, Coburn 1602B	
BORAGINACEAE	*Lithospermum incisum*	Lehm.	narrowleaf stoneseed	N	Per	Herb		Coburn 490, Coburn 617	*Batschia linearifolia, Lithospermum angustifolium, L. linearifolium, L. mandanense*
BORAGINACEAE	*Pectocarya setosa*	A. Gray	moth combseed	N	Ann	Herb		Coburn 114, Coburn 642	*Gruvelia setosa*
BORAGINACEAE	*Phacelia affinis*	A. Gray	limestone phacelia	N	Ann	Herb		Baker 8980	
BORAGINACEAE	*Phacelia bombycina*	Woot. & Standl.	Mangas Spring phacelia	N	Ann	Herb		Coburn 1711, Coburn 572b	*Phacelia tenuipes*
BORAGINACEAE	*Phacelia caerulea*	Greene	skyblue phacelia	N	Ann	Herb		Coburn 572a	*Phacelia intermedia*
BORAGINACEAE	*Phacelia cryptantha*	Greene	hiddenflower phacelia	N	Ann	Herb		Coburn 1599, Coburn 76	*Phacelia cryptantha var. derivata*
BORAGINACEAE	*Phacelia rupestris*	Greene	rock phacelia	N	Ann	Herb		Coburn 1350b, Coburn 218	*Phacelia congesta var. rupestris*
BORAGINACEAE	*Plagiobothrys arizonicus*	(A. Gray) Greene ex A. Gray	Arizona popcornflower	N	Ann	Herb		Coburn 466b, Coburn 1721	
BORAGINACEAE	*Plagiobothrys tenellus*	(Nutt. ex Hook.) A. Gray	Pacific popcornflower	N	Ann	Herb	FACU	Coburn 26	

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BORAGINACEAE	*Tiquilia canescens*	(DC.) A. Richards.	woody crinklemat	N	Per	Subshrub		Coburn 78, Coburn 1239	
BRASSICACEAE	*Athysanus pusillus*	(Hook.) Greene	common sandweed	N	Ann	Herb		Coburn 37	*Athysanus pusillus var. glabrior, Thysanocarpus oblongifolius, Thysanocarpus pusillus*
BRASSICACEAE	*Boechera perennans*	(S. Wats.) W.A. Weber	perennial rockcress	N	Per	Subshrub		Coburn 1561, Coburn 469	*Arabis perennans, Arabis angulata, Arabis eremophila, Arabis gracilenta, Arabis recondita*
BRASSICACEAE	*Capsella bursa-pastoris*	(L.) Medik.	shepherd's purse	I	Ann	Herb	FACU	Coburn 32	*Bursa bursa-pastoris, Bursa gracilis, Capsella rubella, Thlaspi bursa-pastoris*
BRASSICACEAE	*Chorispora tenella*	(Pallas) DC.	crossflower	I	Ann	Herb		Coburn 199, Coburn 31	*Chorispermum tenellum, Crucifera tenella, Raphanus monnetii, R. tenellus*
BRASSICACEAE	*Descurainia pinnata*	(Walt.) Britt.	western tansymustard	N	Ann	Herb		Coburn 34, Coburn 1728	
BRASSICACEAE	*Draba cuneifolia*	Nutt. ex Torr. & A. Gray	wedgeleaf draba	N	Ann	Herb		Coburn 29	
BRASSICACEAE	*Erysimum capitatum*	(Dougl. ex Hook.) Greene	sanddune wallflower	N	Per	Herb		Coburn 50	
BRASSICACEAE	*Erysimum repandum*	L.	spreading wallflower	I	Ann	Herb		Coburn 522, Coburn 33	*Cheirinia repanda*
BRASSICACEAE	*Hesperidanthus linearifolius*	(A. Gray) Rydb.	slimleaf plainsmustard	N	Per	Subshrub		Coburn 865, Coburn 1814	*Schoenocrambe linearifolia, Sisymbrium linearifolium, Thelypodiopsis linearifolia*
BRASSICACEAE	*Lepidium densiflorum*	Schrad.	common pepperweed	N	Ann	Herb	UPL	Coburn 840, Coburn 143	*Lepidium elongatum, Linnaeus neglectum, Linnaeus pubicarpum, Linnaeus ramosum*

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BRASSICACEAE	*Lepidium draba*	L.	whitetop	I	Per	Herb		Coburn 131a, Coburn 215	*Cardaria draba*
BRASSICACEAE	*Lepidium lasiocarpum*	Nutt.	shaggyfruit pepperweed	N	Ann	Herb		Coburn 1580B, Coburn 145	
BRASSICACEAE	*Lepidium montanum*	Nutt.	mountain pepperweed	N	Per	Subshrub		Coburn 824, Coburn 131	*Lepidium montanum var. glabrum*
BRASSICACEAE	*Lepidium virginicum*	L.	Virginia pepperweed	N	Ann	Herb	FACU	Coburn 35, Coburn 1568	
BRASSICACEAE	*Matthiola longipetala*	(Vent.) DC.	night scented stock	I	Ann	Herb		Coburn 124, Coburn 795	*Cheiranthus longipetalus, Matthiola aspera, Matthiola kralikii, M. oxyceras*
BRASSICACEAE	*Nasturtium officinale*	R. Br.	watercress	I	Per	Herb	OBL	Coburn 60, Coburn 999	*Rorippa nasturtium-aquaticum, Sisymbrium nasturtium-aquaticum*
BRASSICACEAE	*Physaria arizonica*	(S. Watson) O'Kane & Al-Shehbaz	Arizona bladderpod	N	Per	Herb		Coburn 756b	*Lesquerella arizonica, Linnaeus arizonica var. nudicaulis, Physaria arizonica var. andrusensis*
BRASSICACEAE	*Physaria cinerea*	(S. Watson) O'Kane & Al-Shehbaz	basin bladderpod	N	Per	Herb		Coburn 1697	*Lesquerella cinerea*
BRASSICACEAE	*Physaria gordonii*	(S. Watson) O'Kane & Al-Shehbaz	Gordon's bladderpod	N	Ann	Herb		Coburn 1581, Coburn 1650	*Lesquerella gordonii, Alyssum gordonii, Vesicaria gordonii*
BRASSICACEAE	*Rorippa palustris*	(L.) Bess.	bog yellowcress	N	Ann/Bien/Per	Herb	OBL	Coburn 183	*Cardamine palustris, Nasturtium palustre, Radicula palustris (L.) Moench*

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BRASSICACEAE	*Sisymbrium altissimum*	L.	tall tumblemustard	I	Ann	Herb	FACU	Coburn 593b, Coburn 619	*Norta altissima*
BRASSICACEAE	*Sisymbrium irio*	L.	London rocket	I	Ann	Herb		Coburn 1582, Coburn 1734	*Norta irio*
BRASSICACEAE	*Streptanthus cordatus*	Nutt.	heartleaf twistflower	N	Per	Herb		Coburn 605	*Streptanthus lemmonii, Caulanthus lemmonii*
BRASSICACEAE	*Thelypodium wrightii*	A. Gray	Wright's thelypody	N	Per	Herb		Coburn 1012	
BRASSICACEAE	*Thysanocarpus curvipes*	Hook.	sand fringepod	N	Ann	Herb		Coburn 1600, Coburn 120	*Thysanocarpus amplectens, Thysanocarpus elegans*
CACTACEAE	*Cylindropuntia leptocaulis*	(DC.) Knuth	Christmas cactus	N	Per	Succ		Coburn 293	*Opuntia leptocaulis*
CACTACEAE	*Cylindropuntia whipplei*	(Engelm. & Bigelow) F.M. Knuth	Whipple cholla	N	Per	Succ		Coburn 771	*Opuntia whipplei*
CACTACEAE	*Echinocereus coccineus*	Engelm.	scarlet hedgehog cactus	N	Per	Succ		Coburn 1596b, 1671	
CACTACEAE	*Echinocereus fasciculatus*	(Engelm. ex B.D. Jackson) L. Benson	pinkflower hedgehog cactus	N	Per	Succ		Coburn 157b	*Many, see Tropicos*
CACTACEAE	*Echinocereus fendleri*	(Engelm.) Sencke ex J.N. Haage	pinkflower hedgehog cactus	N	Per	Succ		Coburn 1584	

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CACTACEAE	*Escobaria missouriensis*	(Sweet) D.R.Hunt	Missouri foxtail cactus	N	Per	Shrub		Coburn 1421	*Coryphantha missouriensis*
CACTACEAE	*Escobaria vivipara*	(Nutt.) Buxb.	spinystar	N	Per	Succ		Coburn 1577	*Coryphantha vivipara*
CACTACEAE	*Opuntia chlorotica*	Engelm. & Bigelow	dollarjoint pricklypear	N	Per	Succ		Wright 1582	
CACTACEAE	*Opuntia engelmannii*	Salm-Dyck	cactus apple	N	Per	Succ		Coburn 697	
CACTACEAE	*Opuntia macrorhiza*	Engelm.	twistspine pricklypear	N	Per	Succ		Baker 16162	
CACTACEAE	*Opuntia phaeacantha*	Engelm.	tulip pricklypear	N	Per	Succ		Coburn 746	*Opuntia superbospina*
CAMPANULACEAE	*Lobelia cardinalis*	L.	cardinalflower	N	Per	Herb	OBL	Coburn 390, Coburn 996	*Lobelia fulgens, L. splendens*
CAMPANULACEAE	*Nemacladus glanduliferus*	Jepson	glandular threadplant	N	Ann	Herb		Quinn 914	
CANNABACEAE	*Celtis reticulata*	Torr.	netleaf hackberry	N	Per	Tree	FAC	Coburn 1595, Coburn 434b	*Celtis laevigata var. reticulata, Celtis douglasii, Celtis occidentalis var. reticulata*
CAPRIFOLIACEAE	*Symphoricarpos oreophilus*	A. Gray	mountain snowberry	N	Per	Shrub		Coburn 638	
CARYOPHYLLACEAE	*Eremogone aberrans*	(M.E Jones) Ikonn.	Mt. Dellenbaugh sandwort	N	Per	Subshrub		Coburn 1694	*Arenaria aberrans*

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CARYOPHYLLACEAE	*Eremogone eastwoodiae var. adenophora*	(Kearney & Peebles) R.L.Hartm. & Rabeler	Eastwood's sandwort	N	Per	Herb		Baker 8988	
CARYOPHYLLACEAE	*Herniaria hirsuta*	L.	hairy rupturewort	I	Ann	Herb		Coburn 2005	
CARYOPHYLLACEAE	*Silene antirrhina*	L.	sleepy silene		Ann	Herb		Coburn 1660, Coburn 582	
CELASTRACEAE	*Canotia holacantha*	Torr.	crucifixion thorn	N	Per	Tree		Coburn 1816, Coburn 1291	
CLEOMACEAE	*Peritoma jonesii*		Jones spiderflower	N	Ann	Herb	FACU	Coburn 375, Coburn 823	*Cleome jonesii, Cleome lutea var. jonesii*
CLEOMACEAE	*Peritoma serrulata*	(Pursh) DC.	Rocky Mountain beeplant	N	Ann	Herb	FACU	Coburn 947	*Cleome serrulata, several others, see Tropicos*
CLEOMACEAE	*Polanisia dodecandra*	(L.) Dc.	redwhisker clammyweed	N	Ann	Herb	FACU	Coburn 1208, Coburn 361	
COMMELINACEAE	*Commelina dianthifolia*	Delile	birdbill dayflower	N	Per	Herb		Coburn 1149	
COMMELINACEAE	*Tradescantia occidentalis*	(Britt.) Smyth	prairie spiderwort	N	Per	Herb	FACU	Baker 9002	
CONVOLVULACEAE	*Convolvulus arvensis*	L.	field bindweed	I	Per	Vine		Baker 8324	*Convolvulus ambigens, Convolvulus incanus, Strophocaulos arvensis*

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CONVOLVULACEAE	*Convolvulus equitans*	Benth.	Texas bindweed	N	Per	Vine	FACU	Coburn 171	*Convolvulus hermannioides, C. simulans*
CONVOLVULACEAE	*Cuscuta pentagona*	Engelm.	fiveangled dodder	N	Ann	Vine		Coburn 357	
CONVOLVULACEAE	*Evolvulus nuttallianus*	J.A. Schultes	shaggy dwarf morning-glory	N	Per	Herb		Coburn 1237, Coburn 407	*Evolvulus argenteus, Evolvulus pilosus*
CONVOLVULACEAE	*Evolvulus sericeus*	Sw.	silver dwarf morning-glory	N	Per	Herb	UPL	Coburn 920, Coburn 1164	
CONVOLVULACEAE	*Ipomoea costellata*	Torr.	crestrib morning-glory	N	Ann	Vine		Coburn 1071, Coburn 1565	*Ipomoea costellata var. costellata*
CONVOLVULACEAE	*Ipomoea cristulata*	Hallier f.	Trans-Pecos morning-glory	N	Ann	Vine		Coburn 1107, Coburn 1205	
CONVOLVULACEAE	*Ipomoea hederacea*	Jacq.	ivyleaf morning-glory	I	Ann	Vine	FACU	Coburn 1278, Coburn 1247	*Many, see Tropicos*
CROSSOSOMATACEAE	*Glossopetalon spinescens*	A. Gray	spiny greasebush	N	Per	Shrub		Coburn 227, Coburn 632	
CUCURBITACEAE	*Cucurbita foetidissima*	Kunth	Missouri gourd	N	Per	Vine		Coburn 1531	*Pepo foetidissima*
CUCURBITACEAE	*Marah gilensis*	Greene	Gila manroot	N	Per	Vine		Coburn 1646, Coburn 504	

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CUCURBITACEAE	*Sicyos laciniatus*	L.	cutleaf bur cucumber	N	Ann	Vine		Coburn 1368, Coburn 1156	*Sicyos ampelophyllus Woot. & Standl., Sicyos laciniata Descourt., Sicyos laciniatus var. genuinus*
CUPRESSACEAE	*Juniperus arizonica*	(R. P. Adams) R. P. Adams	Arizona juniper	N	Per	Tree		Baker 8945	*Juniperus coahuilensis var. arizonica*
CUPRESSACEAE	*Juniperus monosperma*	(Engelm.) Sarg.	oneseed juniper	N	Per	Tree		Coburn 1804, Coburn 1117	*Juniperus occidentail var. gymnocarpa, Sabina monosperma*
CUPRESSACEAE	*Juniperus osteosperma*	(Torr.) Little	Utah juniper	N	Per	Tree		Coburn 479, Coburn 1116	*Many, see Tropicos*
CYPERACEAE	*Carex hystericina*	Muhl. ex Willd.	bottlebrush sedge	N	Per	Gram	OBL	Coburn 354	
CYPERACEAE	*Carex occidentalis*	Bailey	western sedge	N	Per	Gram		Coburn 780	*Carex neomexicana*
CYPERACEAE	*Carex pellita*	Muhl ex Willd.	woolly sedge	N	Per	Gram	OBL	Coburn 197, Coburn 250	*Carex lanuginosa, Carex lasiocarpa var. latifolia*
CYPERACEAE	*Carex praegracilis*	W. Boott	clustered field sedge	N	Per	Gram	FACW	Coburn 189, Coburn 1790	*Carex camporum*
CYPERACEAE	*Carex senta*	Boott	swamp sedge	N	Per	Gram	OBL	Coburn 100, Coburn 1590	
CYPERACEAE	*Carex vulpinoidea*	Michx.	fox sedge	N	Per	Gram	OBL	Baker 8547	

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CYPERACEAE	*Cyperus esculentus*	L.	yellow nutsedge	I	Per	Gram	FACW	Coburn 1341, Coburn 1139	
CYPERACEAE	*Cyperus fendlerianus*	Boeckl.	Fendler's flatsedge	N	Per	Gram	FAC	Coburn 1174	*Mariscus fendlerianus*
CYPERACEAE	*Cyperus niger*	Ruiz & Pav.	black flatsedge	N	Per	Gram	FACW	Coburn 991, Coburn 1469	*Cyperus diandrus var. capitatus, Cyperus melanostachyus, Pycreus niger*
CYPERACEAE	*Cyperus odoratus*	L.	fragrant flatsedge	N	Ann	Gram	FACW	Coburn 1018	*Cyperus acicularis, Cyperus eggersii, Cyperus engelmannii, Cyperus longispicatus*
CYPERACEAE	*Cyperus retroflexus*	Buckl.	oneflower flatsedge	N	Per	Gram		Coburn 964, Coburn 883	*Cyperus pseudothrsiflorus, Cyperus uniflorus*
CYPERACEAE	*Cyperus squarrosus*	L.	bearded flatsedge	N	Ann	Gram	OBL	Coburn 1152	*Cyperus aristatus, Cyperus aristatus var. runyonii, Cyperus inflexus, Cyperus squarrosus var. runyonii*
CYPERACEAE	*Eleocharis macrostachya*	Britt.	pale spikerush	N	Per	Gram		Coburn 165, Coburn 813	
CYPERACEAE	*Eleocharis palustris*	(L.) Roemer & J.A. Schultes	common spikerush	N	Per	Gram	OBL	Coburn 299	*Eleocharis calva var. austrails, E. macrostachya, E. mammillata, E. palustris var. austrails, E. palustris var. major, E. perlonga, E. smallii, E. smallii var. major, E. xyridiformis*
CYPERACEAE	*Eleocharis parishii*	Britt.	Parish's spikerush	N	Per	Gram	FACW	Coburn 169, Coburn 668	*Eleocharis disciformis, Eleocharis montevidensis var. parishii*
CYPERACEAE	*Eleocharis rostellata*	(Torr.) Torr.	beaked spikerush	N	Per	Gram	OBL	Baker 9642	*Eleocharis rostellata var. congdonii, E. rostellata var. occidentails, Scirpus rostellatus*

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CYPERACEAE	*Schoenoplectus acutus*	(Muhl. ex Bigelow) A.& D. Löve	hardstem bulrush	N	Per	Gram	OBL	Coburn 202	*Scirpus acutus*
CYPERACEAE	*Schoenoplectus americanus*	(Pers.) Volk. ex Schinz & R. Keller	chairmaker's bulrush	N	Per	Gram	OBL	Coburn 1770, Coburn 841	*Scirpus americanus, Scirpus chilensis, Scirpus conglomeratus, Scirpus olneyi*
CYPERACEAE	*Schoenoplectus pungens*	(Vahl) Palla	common threesquare	N	Per	Gram	OBL	Coburn 1751, Coburn 186	*Scirpus pungens, Scirpus badius, others see Tropicos*
CYPERACEAE	*Schoenoplectus tabernaemontani*	(K.C. Gmel.) Palla	softstem bulrush	N	Per	Gram	OBL	Hodgson 1 0961, Hazelton 323	*Many, see Tropicos*
ELAEAGNACEAE	*Elaeagnus angustifolia*	L.	Russian olive	I	Per	Tree	FAC	Coburn 1774B	*Elaeagnus angustifolia var. orientalis*
EPHEDRACEAE	*Ephedra viridis*	Coville	Mormon tea	N	Per	Shrub		Coburn 788, Coburn 500	
EQUISETACEAE	*Equisetum arvense*	L.	field horsetail	N	Per	Herb	FAC	Coburn 1475	*Equisetum arvense var. alpestre, Equisetum arvense var. boreale, Equisetum calderi*
EQUISETACEAE	*Equisetum laevigatum*	A. Braun	smooth horsetail	N	Per	Herb	FACW	Coburn 66, Coburn 1771	*Equisetum funstonii, E. kansanum, E. laevigatum subsp. funstonii, Hippochaete laevigata*
ERICACEAE	*Arctostaphylos pungens*	Kunth	pointleaf manzanita	N	Per	Shrub		Coburn 761, Coburn 1297	*Arctostaphylos chaloneorum, Arctostaphylos pseudopungens, Arctostaphylos pungens subsp. chaloneorum*
EUPHORBIACEAE	*Acalypha neomexicana*	Muell.-Arg.	New Mexico copperleaf	N	Ann	Herb		Coburn 1496, Coburn 364	

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EUPHORBIACEAE	*Argythamnia mercurialina*	(Nutt.) Muell.-Arg.	tall silverbush	N	Per	Herb		Coburn 935	
EUPHORBIACEAE	*Croton lindheimerianus*	Scheele	threeseed croton	N	Ann	Herb		Coburn 1915	
EUPHORBIACEAE	*Croton texensis*	(Klotzsch) Muell.-Arg.	Texas croton	N	Ann	Herb		Coburn 85, Coburn 376B	
EUPHORBIACEAE	*Euphorbia abramsiana*	(L.C. Wheeler) Koutnik	Abrams' sandmat	N	Ann	Herb		Coburn 1918	*Chamaesyce abramsiana*
EUPHORBIACEAE	*Euphorbia albomarginata*	(Torr. & A. Gray) Small	whitemargin sandmat	N	Per	Herb		Coburn 1067, 1073, 152	*Chamaesyce albomarginata*
EUPHORBIACEAE	*Euphorbia capitellata*	(Engelm.) Millsp.	head sandmat	N	Per	Herb		Coburn 1218, 1367	*Chamaesyce pycnanthema, Chamaesyce capitellata, Euphorbia pycnanthema*
EUPHORBIACEAE	*Euphorbia exstipulata*	Engelm.	squareseed spurge	N	Ann	Herb		Coburn 1935, Coburn 450	
EUPHORBIACEAE	*Euphorbia fendleri*	(Torr. & A. Gray) Small	Fendler's sandmat	N	Per	Herb		Coburn 1054, 1241	*Euphorbia fendleri, Euphorbia fendleri var. typica*
EUPHORBIACEAE	*Euphorbia glyptosperma*	(Engelm.) Small	ribseed sandmat	N	Ann	Herb		Coburn 1225, 1381	*Euphorbia glyptosperma*
EUPHORBIACEAE	*Euphorbia hyssopifolia*	(L.) Small	hyssopleaf sandmat	N	Ann/Per	Herb	FACU	Coburn 1021, 1219, 1392	*Chamaesyce brasiliensis, Euphorbia brasiliensis, Euphorbia hyssopifolia*
EUPHORBIACEAE	*Euphorbia indivisa*	(Kunth) Millsp.	royal sandmat	N	Ann	Herb		Coburn 1135, 1228, 1511	

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EUPHORBIACEAE	*Euphorbia micromera*	(Boiss. ex Engelm.) Woot. & Standl.	Sonoran sandmat	N	Ann	Herb		Coburn 1223, 1382	*Chamaesyce micromera*
EUPHORBIACEAE	*Euphorbia polycarpa*	Benth.	smallseed sandmat	N	Per	Herb		Coburn 556	*Chamaesyce polycarpa var. hirtella*
EUPHORBIACEAE	*Euphorbia prostrata*	(Ait.) Small	prostrate sandmat	N	Ann	Herb	FACU	Coburn 1100, 1386	*Chamaesyce prostrata, Euphorbia chamaesyce*
EUPHORBIACEAE	*Euphorbia revoluta*	(Engelm.) Small	threadstem sandmat	N	Ann	Herb		Coburn 1050, 1387	*Chamaesyce revoluta, Chamaesyce revoluta*
EUPHORBIACEAE	*Euphorbia serpyllifolia*	(Pers.) Small	thymeleaf sandmat	N	Ann	Herb		Coburn 1066, 1099, 1236	
EUPHORBIACEAE	*Euphorbia serrula*	(Engelm.) Woot. & Standl.	sawtooth sandmat	N	Ann	Herb		Coburn 1065, 1098	*Chamaesyce serrula Engelm.*
EUPHORBIACEAE	*Euphorbia spathulata*	Lam.	warty spurge	N	Ann	Herb	FAC	Coburn 1665, Coburn 156	*Many, see Tropicos*
EUPHORBIACEAE	*Euphorbia stictospora*	(Engelm.) Small	slimseed sandmat	N	Ann	Herb		1338, 1474	*Chamaesyce strictospora*
EUPHORBIACEAE	*Tragia ramosa*	Torr.	branched noseburn	N	Per	Herb		Coburn 238, Coburn 717	*Tragia angustifolia, Tragia nepetifolia var. ramosa, Tragia stylaris*
FABACEAE	*Acacia greggii*	A. Gray	catclaw acacia	N	Per	Shrub	FACU	Coburn 1923, Coburn 803	*Senegalia greggii*
FABACEAE	*Acmispon brachycarpus*	(Benth.) D.D.Sokoloff	foothill deervetch	N	Ann	Herb		Coburn 1687, Coburn	*Lotus humistratus, Lotus brachycarpus, Hosackia brachycarpa*

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								573b, Coburn 483	
FABACEAE	*Acmispon mearnsii*	(Britton) Brouillet	Mearns' bird's-foot trefoil	N	Per	Herb		Coburn 1181, Coburn 246	*Lotus mearnsii*
FABACEAE	*Amorpha fruticosa*	L.	false indigo bush	N	Per	Shrub	FACW	Coburn 295, Coburn 793	
FABACEAE	*Astragalus calycosus var. scaposus*	(A. Gray) M.E. Jones	Torrey's milkvetch	N	Per	Herb		Coburn 132, Coburn 1585, Coburn 239	
FABACEAE	*Astragalus didymocarpus*	Hook. & Arn.	dwarf white milkvetch	N	Ann	Herb		Coburn 1659	
FABACEAE	*Astragalus lentiginosus var. diphysus*	(A. Gray) M.E. Jones	freckled milkvetch	N	Per	Herb		Coburn 627	*Astragalus araneosus, Astragalus diphysus*
FABACEAE	*Astragalus lentiginosus var. wilsonii*	(Greene) Barneby	freckled milkvetch	N	Per	Herb	UPL	Coburn 24, Baker 8951	*Many, see Tropicos*
FABACEAE	*Astragalus newberryi*	A. Gray	Newberry's milkvetch	N	Per	Herb		Coburn 1578, Coburn 145	*Many, see Tropicos*
FABACEAE	*Astragalus nuttallianus*	Dc.	smallflowered milkvetch	N	Ann	Herb		Coburn 631, Coburn 53	
FABACEAE	*Astragalus subcinereus*	A. Gray	Siler's milkvetch	N	Per	Herb		Coburn 1656	*Several, see Tropicos*
FABACEAE	*Astragalus tephrodes var. brachylobus*	(A. Gray) Barneby	ashen milkvetch	N	Per	Herb		Coburn 1604, Coburn 587	*Many, see Tropicos*

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FABACEAE	*Astragalus wootonii*	A.Gray	halfmoon milkvetch	N	Per	Herb		Coburn 1693B	
FABACEAE	*Caesalpinia gilliesii*	(Hook.) Wallich ex D. Dietr.	bird-of-paradise shrub	I	Per	Tree		Coburn 1032, Coburn 728	*Erythrostemon gilliesii, Poinciana gilliesii*
FABACEAE	*Chamaecrista nictitans*	(L.) Moench	partridge pea	N	Ann	Herb		Coburn 1314, Coburn 1163	*Cassia nictitans*
FABACEAE	*Dalea albiflora*	A. Gray	whiteflower prairie clover	N	Per	Subshrub		Coburn 1926, Coburn 399	*Dalea ordiae, Petalostemon pilosulus*
FABACEAE	*Dalea aurea*	Nutt. ex Pursh	golden prairie clover	N	Per	Subshrub		Coburn 1193a	*Psoralea aurea*
FABACEAE	*Dalea brachystachys*	A.Gray	Fort Bowie prairie clover	N	Ann/Bien	Herb		Coburn 1927, Coburn 1086	*Dalea lemmonii, Dalea brachystachya*
FABACEAE	*Dalea candida var. oligophylla*	(Torr.) Shinners	white prairie clover	N	Per	Subshrub		Coburn 335b, Coburn 1809	*Many, see Tropicos*
FABACEAE	*Dalea formosa*	Torr.	featherplume	N	Per	Shrub		Coburn 1401, Coburn 54	
FABACEAE	*Dalea nana*	Torr. ex A. Gray	dwarf prairie clover	N	Per	Herb		Coburn 1396, Coburn 683	
FABACEAE	*Dalea searlsiae*	(A. Gray) Barneby	Searls' prairie clover	N	Per	Herb		Coburn 1710	*Kuhnistera searlsiae, Petalostemon searlsiae*

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FABACEAE	*Desmanthus cooleyi*	(Eat.) Trel.	Cooley's bundleflower	N	Per	Herb		Coburn 923, Coburn 978	
FABACEAE	*Desmodium neomexicanum*	A. Gray	New Mexico ticktrefoil	N	Ann	Herb		Coburn 1153, Coburn 1904	*Meibomia neomexicana*
FABACEAE	*Glycyrrhiza lepidota*	Pursh	American licorice	N	Per	Herb	FAC	Coburn 216	*Glycyrrhiza glutinosa, Glycyrrhiza lepidota var. glutinosa*
FABACEAE	*Hoffmannseggia drepanocarpa*	A.Gray	sicklepod holdback	N	Per	Herb		Coburn 622	*Caesalpinia drepanocarpa*
FABACEAE	*Lathyrus eucosmus*	Butters & St. John	bush vetchling	N	Per	Vine		Coburn 190	*Orobus polymorphus*
FABACEAE	*Lotus corniculatus*	L.	bird's-foot trefoil	I	Per	Herb	FAC	Coburn 250b, Coburn 821	*Lotus caucasicus*
FABACEAE	*Lupinus brevicaulis*	S. Wats.	shortstem lupine	N	Ann	Herb		Coburn 1698, Coburn 212	*Lupinus dispersus, Linnaeus scaposus*
FABACEAE	*Lupinus concinnus*	J.G. Agardh	bajada lupine	N	Ann	Herb		Coburn 1685, Coburn 569a	
FABACEAE	*Medicago lupulina*	L.	black medick	I	Ann/Per	Herb	FAC	Coburn 267, Coburn 1005	*Medica lupulina*
FABACEAE	*Medicago minima*	(L.) L.	little burclover	I	Ann	Herb		Quinn 714	

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FABACEAE	*Melilotus alba*	Medikus	white sweetclover	I	Ann	Herb	FACU	Coburn 997, Coburn 312	*Melilotus albus*
FABACEAE	*Melilotus officinalis*	(L.) Lam.	sweetclover	I	Per	Herb	FACU	Coburn 895	
FABACEAE	*Mimosa aculeaticarpa*	Ortega	catclaw mimosa	N	Per	Tree		Coburn 275	*Mimosa biuncifera, Mimosa acanthocarpa, Acacia acanthocarpa*
FABACEAE	*Ottleya wrightii*	(A.Gray) D.D.Sokoloff	Wright's deervetch	N	Per	Herb		Baker 10321	*Hosackia wrightii, Lotus wrightii*
FABACEAE	*Pediomelum verdiense*	S. L. Welsh & M. Licher	Verde Formation breadroot	N	Per	Herb		Coburn 1758b	
FABACEAE	*Phaseolus acutifolius var. latifolius*	Freeman	tepary bean	N	Ann	Vine		Coburn 1490, Coburn 1206	
FABACEAE	*Phaseolus angustissimus*	A. Gray	slimleaf bean	N	Per	Herb/Vine		Coburn 1489, Coburn 103	*Phaseolus angustissimus var. latus*
FABACEAE	*Prosopis velutina*	Wooton	velvet mesquite	N	Per	Shrub/Tree		Coburn 339b	*Prosopis articulata, Prosopis chilensis var. velutina, Prosopis juliflora var. velutina*
FABACEAE	*Psoralidium tenuiflorum*	(Pursh) Rydb.	slimflower scurfpea	N	Per	Herb		Coburn 1092, Coburn 1765	*Psoralea tenuiflora*
FABACEAE	*Rhynchosia senna*	Gillies ex Hook.	Texas snoutbean	N	Per	Vine		Coburn 753, Coburn 1232	

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FABACEAE	*Robinia neomexicana*	A. Gray	New Mexico locust	N	Per	Tree		Coburn 778, Coburn 1730	*Robinia luxurians*
FABACEAE	*Senna bauhinioides*	(A. Gray) Irwin & Barneby	twinleaf senna	N	Per	Subshrub		Coburn 319, Coburn 926	*Cassia bauhinioides*
FABACEAE	*Sophora nuttalliana*	B.L. Turner	silky sophora	N	Per	Herb		Coburn 1737, Coburn 141	*Sophora sericea*
FABACEAE	*Trifolium fragiferum*	L.	strawberry clover	I	Per	Herb	FACU	Coburn 348, Coburn 1001	
FABACEAE	*Trifolium mucronatum. ssp. lacerum*	Willd. (Greene) J.M. Gillett	cow clover	N	Per	Herb	FACW	Coburn 1799	*Trifolium arizonicum, Trifolium involucratum var. arizonicum, Trifolium wormskioldii var. arizonicum*
FABACEAE	*Trifolium repens*	L.	white clover	I	Per	Herb	FACU	Coburn 897, Coburn 262	
FABACEAE	*Vicia ludoviciana*	Nutt.	Louisiana vetch	N	Ann	Vine	UPL	Coburn 618, Coburn 25	
FAGACEAE	*Quercus gambelii*	Nutt.	Gambel oak	N	Per	Tree	UPL	Coburn 1738, Coburn 776	
FAGACEAE	*Quercus gambelii X turbinella*			N	Per	Tree/Shrub	UPL	Coburn 276, Coburn 1800	
FAGACEAE	*Quercus grisea*	Liebm.	gray oak	N	Per	Tree		Coburn 476	
FAGACEAE	*Quercus palmeri*	Engelm.	Palmer oak	N	Per	Shrub		Coburn 1464, Coburn 477	*Quercus dunnii, Quercus chrysolepis var. palmeri*

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FAGACEAE	*Quercus turbinella*	Greene	Sonoran scrub oak	N	Per	Tree		Coburn 474b, Coburn 1764	*Quercus dumosa var. turbinella*
FOUQUIERIACEAE	*Fouquieria splendens*	Engelm.	ocotillo	N	Per	Shrub		Coburn 503, Coburn 551	
GARRYACEAE	*Garrya wrightii*	Torr.	Wright's silktassel	N	Per	Shrub		Coburn 700, Coburn 1471	
GENTIANACEAE	*Frasera albomarginata*	S. Wats.	desert frasera	N	Per	Herb		Baker 9280	*Leucocraspedum albomarginatum, Swertia albomarginata*
GENTIANACEAE	*Zeltnera calycosa*	(Buckley) G.Mans.	Arizona centaury	N	Ann	Herb	FACW	Farner year 1996 ASC	*Centaurium calycosum, Centaurodes calycosum, Erythraea calycosa*
GERANIACEAE	*Erodium cicutarium*	(L.) L'Hér. ex Ait.	redstem stork's bill	I	Ann	Herb		Coburn 67	
GERANIACEAE	*Erodium texanum*	A. Gray	Texas stork's bill	N	Ann	Herb		Coburn 493	
GROSSULARIACEAE	*Ribes aureum*	Pursh	golden currant	N	Per	Shrub	FAC	Coburn 774	
GROSSULARIACEAE	*Ribes cereum*	Dougl.	wax currant	N	Per	Shrub		Coburn 472	
HALORAGACEAE	*Myriophyllum spicatum*	L.	Eurasian watermilfoil	I	Per	Herb	OBL	Ricketson 2597	
HYDRANGEACEAE	*Fendlera rupicola*	A. Gray	cliff fendlerbush	N	Per	Shrub		Coburn 134, Coburn 1766	*Fendlera falcata*

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IRIDACEAE	*Sisyrinchium demissum*	Greene	stiff blue-eyed grass	N	Per	Herb	OBL	Coburn 1750	*Sisyrinchium demissum var. amethystinum, Sisyrinchium longipedunculatum*
JUGLANDACEAE	*Juglans major*	(Torr.) Heller	Arizona walnut	N	Per	Tree	FAC	Coburn 828, Coburn 188	*Juglans elaeopyren, J. microcarpa var. major, J. rupestris var. major*
JUNCACEAE	*Juncus articulatus*	L.	jointleaf rush	N	Per	Gram	OBL	Coburn 887, Coburn 206	*Juncus articulatus var. obtusatus, Luzula hyperborea*
JUNCACEAE	*Juncus balticus*	Willd.	Baltic rush	N	Per	Gram	FACW	Coburn 166	*Juncus arcticus var. balticus*
JUNCACEAE	*Juncus interior*	Wiegand	inland rush	N	Per	Gram	FACW	Coburn 278	*Juncus dichotomus, many others, see Tropicos*
JUNCACEAE	*Juncus mexicanus*	Willd. ex J.A. & J.H. Schultes	Mexican rush	N	Per	Gram	FACW	Coburn 1780, Coburn 203	*Juncus balticus var. mexicanus*
JUNCACEAE	*Juncus nevadensis*	S. Watson	Sierra rush	N	Per	Gram		Baker 12600	*Juncus badius*
JUNCACEAE	*Juncus torreyi*	Coville	Torrey's rush	N	Per	Gram	FACW	Coburn 1017, Coburn 346	
JUNCACEAE	*Juncus xiphioides*	E. Mey.	irisleaf rush	N	Per	Gram	OBL	Coburn 261, Coburn 1797	
KRAMERIACEAE	*Krameria erecta*	Willd. ex J.A. Schultes	littleleaf ratany	N	Per	Shrub		Coburn 1238, Coburn 553	*Krameria glandulosa, K. imparata, K. parvifolia*
LAMIACEAE	*Clerodendrum coulteri*	(A. Gray) Govaerts	Coulter's wrinklefruit	N	Per	Herb		Coburn 703, 910, 1074	*Tetraclea angustifolia, Tetraclea coulteri, Tetraclea subinclusa*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
LAMIACEAE	*Dracocephalum parviflorum*	Nutt.	American dragonhead	N	Ann	Herb	FACU	Coburn 1723, Coburn 30	
LAMIACEAE	*Hedeoma diffusa*	Greene	spreading false pennyroyal	N	Per	Herb		Baker 9004	*Hedeoma blepharodonta Greene, Hedeoma diffusum*
LAMIACEAE	*Hedeoma drummondii*	Benth.	Drummond's false pennyroyal	N	Per	Herb		Coburn 90	*Hedemoma campora, H. ciliat, H. longiflora, H. ovata*
LAMIACEAE	*Hedeoma nana subsp. nana*	(Torr.) Briq.	dwarf false pennyroyal	N	Per	Herb		Coburn 445, Coburn 1458	
LAMIACEAE	*Hedeoma oblongifolia*	(A. Gray) A. Heller	oblong-leaf false pennyroyal	N	Per	Herb		Coburn 1132, Coburn 1393	
LAMIACEAE	*Lamium amplexicaule*	L.	henbit deadnettle	I	Ann	Herb		Coburn 1279, Coburn 47	*Lamium amplexicaule var. album*
LAMIACEAE	*Lycopus asper*	Greene	rough bugleweed	N	Per	Herb	OBL	Coburn 1508, Coburn 958	*Locypus lucidus*
LAMIACEAE	*Marrubium vulgare*	L.	horehound	I	Per	Herb	FACU	Coburn 629	
LAMIACEAE	*Mentha spicata*	L.	spearmint	I	Per	Herb	OBL	Coburn 822, Coburn 102	*Mentha cordifolia, M. longifolia, M. viridis*
LAMIACEAE	*Monarda pectinata*	Nutt.	pony beebalm	N	Ann	Herb		Coburn 1778	
LAMIACEAE	*Salvia dorrii subsp. mearnsii*	(Britt.) McClintock	Mearns sage	N	Per	Shrub		Coburn 231, 678, 762	*Audibertia mearnsii , Salvia carnosa subsp. Mearnsii*

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LAMIACEAE	*Salvia reflexa*	Hornem.	lanceleaf sage	N	Ann	Herb		Coburn 929, Coburn 1112	*Salvia lancifolia*
LAMIACEAE	*Salvia subincisa*	Benth.	sawtooth sage	N	Ann	Herb		Coburn 1311, Coburn 459	
LAMIACEAE	*Scutellaria lateriflora*	L.	blue skullcap	N	Per	Herb	FACW	Coburn 1014, Coburn 401a	
LAMIACEAE	*Trichostema brachiatum*	L.	fluxweed	N	Ann	Herb		Wright 1629	*Isanthus brachiatus., Isanthus brachiatus var. linearis*
LILIACEAE	*Calochortus flexuosus*	S. Wats.	winding mariposa lily	N	Per	Herb		Coburn 603, Coburn 557	
LILIACEAE	*Calochortus kennedyi*	Porter	desert mariposa lily	N	Per	Herb		Coburn 628, Coburn 1749	
LINACEAE	*Linum lewisii*	Pursh	Lewis flax	N	Per	Herb		Coburn 1673	
LINACEAE	*Linum puberulum*	(Engelm.) Heller	plains flax	N	Ann	Herb		Coburn 602, Coburn 122	*Cathartolinum puberulum, Linum rigidum var. puberulum, Mesynium puberulum*
LOASACEAE	*Mentzelia albicaulis*	(Dougl. ex Hook.) Dougl. ex Torr. & A. Gray	whitestem blazingstar	N	Ann	Herb		Coburn 89, Coburn 1631	*Acrolasia albicaulis, Mentzelia montana, Mentzelia gracilis, Mentzelia mojavensis*
LOASACEAE	*Mentzelia longiloba var. yavapaiensis*	J. J. Schenk & L. Hufford	Adonis blazingstar	N	Per	Herb		Coburn 104, 1484	*Mentzelia multiflora*

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LYTHRACEAE	*Punica granatum*	L.	pomegranate	I	Per	Tree		Coburn 727	*Punica florida, Punica grandiflora, Punica nana, Punica spinosa*
MALPIGHIACEAE	*Cottsia gracilis*	(A. Gray) W.R. Anderson	slender janusia	N	Per	Herb/Vine		Coburn 596	*Janusia gracilis*
MALVACEAE	*Abutilon parvulum*	A. Gray	dwarf Indian mallow	N	Per	Subshrub		Coburn 1929, Coburn 298	
MALVACEAE	*Anoda cristata*	(L.) Schlecht.	crested anoda	N	Ann	Herb	FAC	Coburn 1451, Coburn 1144	*Anoda acerifolia, Anoda lavaterioides, Sida cristata*
MALVACEAE	*Anoda pentaschista*	A. Gray	field anoda	N	Ann	Herb		Coburn 1963, Coburn 1355	*Many, see Tropicos*
MALVACEAE	*Rhynchosida physocalyx*	(A. Gray) Fryxell	buffpetal	N	Per	Herb		Coburn 1919	*Sida physocalyx*
MALVACEAE	*Sida abutifolia*	P. Mill.	spreading fanpetals	I	Per	Herb		Coburn 1456, Coburn 326a	*Sida filicaulis, Sida filiformis, Sida procumbens, Sida supina*
MALVACEAE	*Sphaeralcea ambigua*	A. Gray	desert globemallow	N	Per	Subshrub		Wright 92-9	
MALVACEAE	*Sphaeralcea fendleri*	A. Gray	Fendler's globemallow	N	Per	Subshrub		Coburn 1351, Coburn 405	*Sphaeralcea leiocarpa*
MALVACEAE	*Sphaeralcea grossulariifolia*	(Hook. & Arn.) Rydb.	gooseberryleaf globemallow	N	Per	Subshrub		Coburn observation	

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MALVACEAE	*Sphaeralcea parvifolia*	A. Nels.	smallflower globemallow	N	Per	Subshrub		Coburn 1527, Coburn 108	*Sphaeralcea arizonica, Sphaeralcea marginata*
MARTYNIACEAE	*Proboscidea parviflora*	(Woot.) Woot. & Standl.	doubleclaw	N	Ann	Herb		Coburn 1514, Coburn 394	*Martynia parviflora, Proboscidea crassibracteata*
MOLLUGINACEAE	*Mollugo cerviana*	(L.) Ser.	threadstem carpetweed	I	Ann	Herb	FAC	Coburn 1115	
MOLLUGINACEAE	*Mollugo verticillata*	L.	green carpetweed	N	Ann	Herb	FACU	Coburn 971	*Mollugo berteriana*
MONTIACEAE	*Calandrinia ciliata*	(Ruiz & Pavón) DC.	fringed redmaids	N	Ann	Herb		Coburn 1554	
MONTIACEAE	*Claytonia perfoliata*	Donn ex Willd.	miner's lettuce	N	Ann	Herb	FAC	Coburn 40	
MONTIACEAE	*Phemeranthus aurantiacus*	(Engelm.) Kiger	orange fameflower	N	Per	Herb		Coburn 1931B, Coburn 318	*Talinum aurantiacum*
MONTIACEAE	*Phemeranthus parviflorus*	(Nutt.) Kiger	sunbright	N	Per	Herb		Coburn 1289, Coburn 179	*Talinum gooddingii, Talinum parviflorum*
MORACEAE	*Morus alba*	L.	white mulberry	I	Per	Tree	FACE	Coburn 1289	
MORACEAE	*Morus microphylla*	Buckl.	Texas mulberry	N	Per	Tree	FACU	Coburn 135, Coburn 714	*Morus confinis, M. crataegifolia, M. grisea, M. radulina*
NYCTAGINACEAE	*Abronia nana*	S. Wats.	dwarf sand verbena	N	Per	Herb		Coburn 624	

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NYCTAGINACEAE	*Allionia incarnata*	L.	trailing windmills	N	Per	Herb		Coburn 1916, Coburn 398	
NYCTAGINACEAE	*Boerhavia coccinea*	P. Mill.	scarlet spiderling	N	Per	Herb		Coburn 328b	*Boerhavia caribaea*
NYCTAGINACEAE	*Boerhavia coulteri*	(Hook. f.) S. Wats.	Coulter's spiderling	N	Ann	Herb		Coburn 941, Coburn 830	*Senkenbergia coulteri*
NYCTAGINACEAE	*Boerhavia erecta*	L.	erect spiderling	N	Ann	Herb	FACU	Coburn 1161, Coburn 847	
NYCTAGINACEAE	*Boerhavia intermedia*	M.E. Jones	fivewing spiderling	N	Ann	Herb		Coburn 368	*Boerhavia erecta var. intermedia*
NYCTAGINACEAE	*Mirabilis albida*	(Walt.) Heimerl	white four o'clock	N	Per	Herb		Coburn 1812, Coburn 692	*Allionia albida, Allionia coahuilensis, Allionia pauciflora, Allionia rotata, Mirabilis dumetorum*
NYCTAGINACEAE	*Mirabilis coccinea*	(Torr.) Benth. & Hook. f.	scarlet four o'clock	N	Per	Herb		Coburn 1805, Coburn 164	*Oxybaphus coccineus*
NYCTAGINACEAE	*Mirabilis linearis*	(Pursh) Heimerl	narrowleaf four o'clock	N	Per	Subshrub		Coburn 1093, Coburn 1821	*Allionia decumbens, A. linearis, Mirabilis decumbens, Oxybaphys angustifolius*
NYCTAGINACEAE	*Mirabilis longiflora*	L.	sweet four o'clock	N	Per	Herb		Coburn 404	*Mirabilis longiflora var. wrightiana*
NYCTAGINACEAE	*Mirabilis multiflora*	(Torr.) A. Gray	Colorado four o'clock	N	Per	Herb		Coburn 1281, Coburn 332a	*Oxybaphus multiflorus*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
NYCTAGINACEAE	*Mirabilis oxybaphoides*	(A. Gray) A. Gray	smooth spreading four o'clock	N	Per	Herb		Coburn 1426, Coburn 1308	*Allioniella oxybaphoides*
NYMPHAEACEAE	*Nymphaea odorata*	Ait.	American white waterlily	N	Per	Herb	OBL	Hodgson 10962	
OLEACEAE	*Forestiera pubescens*	Nutt.	stretchberry	N	Per	Shrub	FACU	Coburn 471, Coburn 249	
OLEACEAE	*Fraxinus anomala var. lowellii*	(Sarg.) Little	singleleaf ash	N	Per	Shrub/Tree		Coburn 1313, Coburn 691	*Fraxinus lowellii*
OLEACEAE	*Fraxinus velutina*	Torr.	velvet ash	N	Per	Tree	FAC	Coburn 743, Coburn 1760	*Fraxinus pennsylvanica ssp velutina, F. velutina var. coriacea, F. velutina var. glabra*
OLEACEAE	*Menodora scabra*	A. Gray	rough menodora	N	Per	Subshrub		Coburn 640, Coburn 1023	*Menodora scabra var. glabrescens, M. scabra var. laevis*
ONAGRACEAE	*Calylophus hartwegii ssp. pubescens*	(A. Gray) Towner & P.H. Raven	Hartweg's sundrops	N	Per	Subshrub		Coburn 1316	
ONAGRACEAE	*Epilobium ciliatum*	Raf.	fringed willowherb	N	Per	Herb	FACW	Coburn 260, Coburn 786b	*Many, see Tropicos*
ONAGRACEAE	*Eremothera chamaenerioides*	(A. Gray) W.L. Wagner & Hoch	longcapsule suncup	N	Ann	Herb		Coburn 1661, Coburn 1565B	*Camissonia chamaenerioides*
ONAGRACEAE	*Ludwigia peploides*	(Kunth) Raven	floating primrose-willow	N	Per	Herb	OBL	Coburn 1016	

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ONAGRACEAE	*Oenothera albicaulis*	Pursh	whitest evening primrose	N	Ann	Herb		Coburn 592b, Coburn 139	
ONAGRACEAE	*Oenothera cespitosa*	Nutt.	tufted evening primrose	N	Per	Herb		Coburn 1640	
ONAGRACEAE	*Oenothera curtiflora*	W.L. Wagner & Hoch	velvetweed	N	Ann	Herb	FACU	Coburn 1006, Coburn 337b	*Gaura mollis, Gaura parviflora*
ONAGRACEAE	*Oenothera elata subsp. hirsutissima*	(A. Gray ex S. Wats.) W. Dietr.	Hooker's evening primrose	N	Per	Herb	FACW	Coburn 1002, Coburn 1534	*Oenothera hookeri ssp. angustifolia, Oenothera hookeri ssp. hirsutissima, Oenothera hookeri*
ONAGRACEAE	*Oenothera elata subsp. hookeri*	(Torr. & A. Gray) W. Dietr. & W.L. Wagner	Hooker's evening primrose	N	Per	Herb	FACW	Coburn 1534	*Oenothera hookeri*
ONAGRACEAE	*Oenothera flava*	(A. Nels.) Garrett	yellow evening primrose	N	Per	Herb	FAC	Coburn 524	
ONAGRACEAE	*Oenothera hexandra subsp. gracilis*	(Ortega) W. L. Wagner & Hoch	harlequinbush	N	Ann	Herb		Coburn 463	*Gaura gracilis, Gaura hexandra subsp gracilis*
ONAGRACEAE	*Oenothera suffrutescens*	(Ser.) W.L. Wagner & Hoch	scarlet beeblossom	N	Per	Herb		Coburn 900, Coburn 1420	*Gaura coccinea*
ORCHIDACEAE	*Epipactis gigantea*	Dougl. ex Hook.	stream orchid	N	Per	Herb	OBL	Coburn 2458, Baker 8563	
OROBANCHACEAE	*Castilleja chromosa*	A.Nelson	wavyleaf Indian paintbrush	N	Per	Herb		Coburn 489, 542	*Castilleja angustifolia var. dubia, Castilleja martinii, Castilleja applegatei subsp. Martinii*

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OROBANCHACEAE	*Castilleja exserta*	(Heller) Chuang & Heckard	exserted Indian paintbrush	N	Ann	Herb		Coburn 1652, Coburn 393	*Orthocarpus purpurascens, Orthocarpus exsertus*
OROBANCHACEAE	*Castilleja integra*	A. Gray	wholeleaf Indian paintbrush	N	Per	Herb		Coburn 351, Coburn 1706	
OROBANCHACEAE	*Castilleja linariifolia*	Benth.	Wyoming Indian paintbrush	N	Per	Herb		Baker 1206 2	
OROBANCHACEAE	*Cordylanthus laxiflorus*	A.Gray	nodding bird's beak	N	Ann	Herb		Baker 9798	
OROBANCHACEAE	*Cordylanthus parviflorus*	(Ferris) Wiggins	purple bird's-beak	N	Ann	Herb		Coburn 1360, Coburn 413	*Cordylanthus glandulosus Pennell & Clokey*
OROBANCHACEAE	*Orobanche cooperi*	(A. Gray) Heller	desert broomrape	N	Ann	Herb		Baker 8952	
OXALIDACEAE	*Oxalis albicans subsp. pilosa*	(Nutt.) Eiten	radishroot woodsorrel	N	Per	Herb		Coburn 51	
PAPAVERACEAE	*Argemone pleiacantha*	Greene	southwestern pricklypoppy	N	Per	Herb		Coburn 752	
PAPAVERACEAE	*Corydalis aurea*	Willd.	scrambled eggs	N	Per	Herb		Coburn 1669, Coburn 41	*Capnoides aureum, Corydalis washingtoniana*
PAPAVERACEAE	*Eschscholzia californica subsp. mexicana*	(Greene) C. Clark	California poppy	N	Ann	Herb		Coburn 491, 594	
PAPAVERACEAE	*Platystemon californicus*	Benth.	creamcups	N	Ann	Herb		Coburn 45	*Many, see Tropicos*

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PHRYMACEAE	*Erythranthe cordata*	(Greene) G.L. Nesom		N	Ann	Herb		Coburn 1648	
PHRYMACEAE	*Erythranthe guttata*	(Fisch. ex DC.) G.L. Nesom	seep monkeyflower	N	Per	Herb	OBL	Coburn 117, Coburn 666	*Mimulus guttatus*
PHRYMACEAE	*Erythranthe rubella*	(A. Gray) N.S. Fraga	little redstem monkeyflower	N	Ann	Herb	FAC	Coburn 28, Coburn 1569	*Mimulus gratioloides, Mimulus rubellus*
PINACEAE	*Pinus edulis*	Engelm.	twoneedle pinyon	N	Per	Tree		Coburn 1772, Coburn 880	*Pinus cembroides var. edulis*
PLANTAGINACEAE	*Linaria dalmatica*	(L.) P. Mill.	Dalmatian toadflax	I	Per	Herb		Coburn 871, Coburn 635	
PLANTAGINACEAE	*Maurandya antirrhiniflora*	Humb. & Bonpl. ex Willd.	roving sailor	N	Per	Vine		Coburn 109, 819	*Antirrhinum maurandioides, Maurandella antirrhiniflora*
PLANTAGINACEAE	*Nuttallanthus texanus*	(Scheele) D.A. Sutton	Texas toadflax	N	Ann	Herb		Coburn 159	*Linaria canadensis var. texana, L. texana*
PLANTAGINACEAE	*Penstemon barbatus*	(Cav.) Roth	beardlip penstemon	N	Per	Herb		Coburn 981	
PLANTAGINACEAE	*Penstemon eatonii subsp. exsertus*	(A. Nels.) Keck	firecracker penstemon	N	Per	Herb		Coburn 702, Coburn 519	
PLANTAGINACEAE	*Penstemon linarioides subsp. sileri*	(A. Gray) Keck	Siler's penstemon	N	Per	Subshrub		Coburn 1925	*Penstemon linarioides subsp. typicus Keck*
PLANTAGINACEAE	*Penstemon ophianthus*	Pennell	coiled anther penstemon	N	Per	Herb		Coburn 757, Coburn 783	*Penstemon jamesii subsp. ophianthus*

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PLANTAGINACEAE	*Penstemon palmeri*	A. Gray	Palmer's penstemon	N	Per	Herb		Coburn 739, Coburn 111	
PLANTAGINACEAE	*Penstemon pseudospectabilis subsp. connatifolius*	(A. Nels.) Keck	desert beardtongue	N	Per	Herb		Coburn 55, 1647	
PLANTAGINACEAE	*Penstemon rostriflorus*	Kellogg	Bridge penstemon	N	Per	Herb		Coburn 870	*Penstemon bridgesii A. Gray, Penstemon bridgesii var. amplexicaulis*
PLANTAGINACEAE	*Penstemon thompsoniae*	(A. Gray) Rydb.	Thompson's beardtongue	N	Per	Subshrub		Coburn 623, Coburn 975	
PLANTAGINACEAE	*Plantago lanceolata*	L.	narrowleaf plantain	I	Per	Herb	FAC	Coburn 1028	*Plantago altissima, Plantago lanceolata var. sphaerostachya*
PLANTAGINACEAE	*Plantago major*	L.	common plantain	I	Per	Herb	FAC	Coburn 101	*Many, see Tropicos*
PLANTAGINACEAE	*Plantago patagonica*	Jacq.	woolly plantain	N	Ann	Herb		Coburn 613, Coburn 70	*Plantago patagonica*
PLANTAGINACEAE	*Schistophragma intermedia*	(A. Gray) Pennell	harlequin spiralseed	N	Ann	Herb		Coburn 1133	
PLANTAGINACEAE	*Veronica anagallis-aquatica*	L.	water speedwell	N	Per	Herb	OBL	Coburn 46	Many, see Tropicos
PLANTAGINACEAE	*Veronica peregrina subsp. xalapensis*	(Kunth) Pennell	hairy purslane speedwell	N	Ann	Herb	OBL	Coburn 163, Coburn 526Coburn 526	
PLATANACEAE	*Platanus wrightii*	S. Wats.	Arizona sycamore	N	Per	Tree	FACW	Coburn 721	*Platanus racemosa var. wrightii*

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POACEAE	*Achnatherum hymenoides*	(Roemer & J.A. Schultes) Barkworth	Indian ricegrass	N	Per	Gram	UPL	Coburn 593	*Eriocoma cuspidata, Oryzopsis hymenoides, Stipa hymenoides*
POACEAE	*Aegilops cylindrica*	Host	jointed goatgrass	I	Ann	Gram		Coburn 236	*Aegilops tauschii, Cylindropyrum cylindricum, Triticum cylindricum*
POACEAE	*Agrostis stolonifera*	L.	creeping bentgrass	I	Per	Gram	FACW	Coburn 314, Coburn 1791	*Agrostis alba var. palustris, A. alba var. stolonifera, A. maritima, A. palustris*
POACEAE	*Aristida adscensionis*	L.	sixweeks threeawn	N	Ann	Gram		Coburn 1083, Coburn 1465	*Aristida adscensionis var. abortiva, A. adscensionis var. modesta, A. fasciculata*
POACEAE	*Aristida purpurea var. longiseta*	(Steud.) Vasey	Fendler threeawn	N	Per	Gram		Coburn 297, Coburn 1453	*Aristida longiseta, A. longiseta, var. rariflora, A. longiseta var. robusta, A. purpurea var. robusta*
POACEAE	*Aristida purpurea var. nealleyi*	(Vasey) Allred	blue threeawn	N	Per	Gram		Coburn 1454	*Aristida glauca, A. nealleyi, A. purpurea var. glauca, A. reverchonii, A. stricta var. nealleyi*
POACEAE	*Aristida purpurea var. purpurea*		purple threeawn	N	Per	Gram		Coburn 1246, Coburn 240	*Aristida purpurea var. laxiflora, A. roemeriana*
POACEAE	*Aristida ternipes var. gentilis*	(Henr.) Allred	spidergrass	N	Per	Gram		Coburn 968, Coburn 1301	*Aristida hamulosa, A. ternipes var. hamulosa, A. ternipes var. minor.*
POACEAE	*Aristida ternipes var. ternipes*		spidergrass	N	Per	Gram		Coburn 425, Coburn 1118	*Aristida ternipes*
POACEAE	*Arundo donax*	L.	giant reed	I	Per	Gram	FACW	Coburn 1271	

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POACEAE	*Avena fatua*	L.	wild oat	I	Ann	Gram		Quinn 717	*Avena fatua var. glabrata, A. fatua var. vilis*
POACEAE	*Bothriochloa barbinodis*	(Lag.) Herter	cane bluestem	N	Per	Gram	UPL	Coburn 432	*Andropogon barbinodis, A. perforatus, B. palmeri*
POACEAE	*Bothriochloa ischaemum*	(L.) Keng	yellow bluestem	I	Per	Gram		Coburn 1912B, Coburn 1261	*Bothriochloa ischaemum var. songarica, Andropogon ischaemum var. songaricus*
POACEAE	*Bothriochloa laguroides subsp. torreyana*	(Steud.) Allred & Gould	silver beardgrass	N	Per	Gram		Coburn 810	*Bothriochloa laguroides var. torreyana, Bothriochloa saccharoides, Andropogon saccharoides var. torreyanus*
POACEAE	*Bouteloua aristidoides*	(Kunth) Griseb.	needle grama	N	Ann	Gram		Coburn 381, Coburn 1207B	
POACEAE	*Bouteloua barbata*	Lag.	sixweeks grama	N	Ann	Gram		Coburn 382, Coburn 1046	*Bouteloua arenosa, Chondrosum barbata, C. exile, C. microstachyum, C. polystachyum, C. subscorpioides*
POACEAE	*Bouteloua curtipendula*	(Michx.) Torr.	sideoats grama	N	Per	Gram		Coburn 438, Coburn 1082	
POACEAE	*Bouteloua eriopoda*	(Torr.) Torr.	black grama	N	Per	Gram		Coburn 1506, 936	*Chondrosum eriopodum*
POACEAE	*Bouteloua gracilis*	(Kunth) Lag. ex Griffiths	blue grama	N	Per	Gram		Coburn 1422, 1105B	*Bouteloua gracilis var. stricta, B. oligostachya, Chondrosum gracile, C. oligostachyum*
POACEAE	*Bouteloua hirsuta*	Lag.	hairy grama	N	Per	Gram		Coburn 1412, 1924	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Bromus arizonicus*	(Shear) Stebbins	Arizona brome	N	Ann	Gram		Coburn 1593	
POACEAE	*Bromus diandrus*	Roth	ripgut brome	I	Ann	Gram		Coburn 64	*Bromus rigidus var. gussonei, Bromus rigidus*
POACEAE	*Bromus japonicus*	Thunb. ex Murr.	Japanese brome	I	Ann	Gram	FACU	Coburn 88, Coburn 1677	
POACEAE	*Bromus marginatus*	Nees Ex Steud.	mountain brome	N	Per	Gram		Coburn 178, Coburn 1682	*Many, see Tropicos*
POACEAE	*Bromus rubens*	L.	red brome	I	Ann	Gram		Coburn 39, Coburn 1678	*Anisantha rubens, Bromus madritensis subsp. rubens, Bromus matritensis subsp. rubens*
POACEAE	*Bromus tectorum*	L.	cheatgrass	I	Ann	Gram		Coburn 63	*Anisantha tectorum, Bromus tectorum var. glabratus, Bromus tectorum var. hirsutus*
POACEAE	*Cenchrus spinifex*	Cav.	coastal sandbur	N	Ann	Gram		Coburn 1309, Coburn 379	*Cenchurus carolinianus, Cenchurus incertus, Cenchurus parviceps, Cenchurus pauciflorus*
POACEAE	*Chloris virgata*	Sw.	feather fingergrass	N	Ann	Gram	FACU	Coburn 1277, Coburn 429	
POACEAE	*Cortaderia selloana*	(J.A. & J.H. Schultes) Aschers. & Graebn.	Uruguayan pampas grass	I	Per	Gram	FACU	Coburn 797	*Cortaderia dioica*
POACEAE	*Crypsis schoenoides*	(L.) Lam.	swamp pricklegrass	I	Ann	Gram	OBL	Coburn 416	*Heleochloa schoenoides*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Cynodon dactylon*	(L.) Pers.	Bermudagrass	I	Per	Gram	FACU	Coburn 372	*Capriola dactylon, Panicum dactylon*
POACEAE	*Dactylis glomerata*	L.	orchardgrass	I	Per	Gram	FACU	Coburn 1762	
POACEAE	*Dasyochloa pulchella*	(Kunth) Willd. ex Rydb.	low woollygrass	N	Per	Gram		Coburn 436, Coburn 1807B	*Erioneuron puchellum, Tridens pulchellus, Triodia pulchella*
POACEAE	*Digitaria californica*	(Benth.) Henr.	Arizona cottontop	N	Per	Gram		Coburn 424, Coburn 243	*Trichachne californica*
POACEAE	*Digitaria cognata*	(J.A. Schultes) Pilger	fall witchgrass	N	Per	Gram		Coburn 1820, Coburn 1505	*Leptoloma cognatum*
POACEAE	*Digitaria sanguinalis*	(L.) Scop.	hairy crabgrass	I	Ann	Gram	FACU	Coburn 1058B, Coburn 1958	*Panicum sanguinale, Syntherisma sanguinalis*
POACEAE	*Dinebra panicea subsp. brachiata*	(Steud.) P. M. Peterson & N. Snow	mucronate sprangeltop	N	Ann/Per	Gram		Coburn 1081, 1204	*Leptochloa panicea subsp. brachiata*
POACEAE	*Disakisperma dubium*	(Kunth) P. M. Peterson & N. Snow	green sprangletop	N	Per	Gram		Coburn 1202, 1350	*Leptochloa dubia, Chloris dubia, Diplachne dubia*
POACEAE	*Distichlis spicata*	(L.) Greene	saltgrass	N	Per	Gram	FAC	Coburn 247	*Distichlis spicata var. borealis, D. spicata var. stolonifera, D. spicata var. stricta,, D. stricta*
POACEAE	*Echinochloa crus-galli*	(L.) Beauv.	barnyardgrass	I	Ann	Gram	FACW	Coburn 309, Coburn 1483	*Panicum crus-galli*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Elymus canadensis*	L.	Canada wildrye	N	Per	Gram	FAC	Coburn 310, Coburn 1789	*Elymus brachystachys, E. canadensis var. brachystachys, E. crescendus, E. robustus*
POACEAE	*Elymus elymoides*	(Raf.) Swezey	squirreltail	N	Per	Gram	FACU	Coburn 621, Coburn 130	*Elymus sitanion, Sitanion slymoides, S. hystrix*
POACEAE	*Elymus glaucus*	Buckl.	blue wildrye	N	Per	Gram	FACU	Coburn 82, Coburn 1406	
POACEAE	*Elymus trachycaulus subsp. trachycaulus*	(Link) Gould ex Shinners	slender wheatgrass	N	Per	Gram	FACU	Coburn 23 3	
POACEAE	*Enneapogon desvauxii*	Desv. ex Beauv.	nineawn pappusgrass	N	Per	Gram		Coburn 1141, Coburn 437	*Pappophorum wrightii*
POACEAE	*Eragrostis cilianensis*	(All.) Vign. ex Janchen	stinkgrass	I	Ann	Gram	FACU	Coburn 1179, Coburn 363	*Eragrostis major, E. megastachya, Poa cilianensis*
POACEAE	*Eragrostis curvula*	(Schrad.) Nees	weeping lovegrass	I	Per	Gram		Baker 12071	*Eragrostis chloromelas, E. curvula var. conferta, E. curvula var. curvula, E. robusta*
POACEAE	*Eragrostis intermedia*	A.S. Hitchc.	plains lovegrass	N	Per	Gram		Coburn 1304, Coburn 433b	
POACEAE	*Eragrostis lehmanniana*	Nees	Lehmann lovegrass	I	Per	Gram		Coburn 440, Coburn 1944	
POACEAE	*Eragrostis mexicana*	(Hornem.) Link	Mexican lovegrass	N	Ann	Gram	FACU	Coburn 1953, Coburn 1354	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Eragrostis pectinacea var. miserrima*	(Fourn.) J. Reeder	desert lovegrass	N	Ann	Gram	FAC	Coburn 1184	*Eragrostis arida, E. tephrosanthos, many others, see Tropicos*
POACEAE	*Eragrostis pectinacea var. pectinacea*	(Michx.) Nees	tufted lovegrass	N	Ann	Gram	FAC	Coburn 279	*Eragrostis caroliniana, E. diffusa, E. purshii, Poa pectinacea*
POACEAE	*Eriochloa acuminata*	(J.Presl) Kunth	tapertip cupgrass	N	Ann	Gram	FACW	Coburn 1128	*Many, see Tropicos*
POACEAE	*Erioneuron pilosum*	(Buckl.) Nash	hairy woollygrass	N	Per	Gram		Coburn 615, Coburn 142	*Tridens pilosus, Uralepis pilosa*
POACEAE	*Festuca arundinacea*	Schreb.	tall fescue	I	Per	Gram	FACU	Coburn 207, Coburn 235, Coburn 162	*Lolium arundinaceum, Schedonorus arundinaceus, many others, see Tropicos*
POACEAE	*Hesperostipa neomexicana*	(Thurb. ex Coult.) Barkworth	New Mexico feathergrass	N	Per	Gram		Coburn 585, Coburn 1746	*Stipa neomexicana*
POACEAE	*Hilaria belangeri*	(Steud.) Nash	curly-mesquite	N	Per	Gram		Coburn 903, Coburn 969	
POACEAE	*Hilaria jamesii*	(Torr.) Benth.	James' galleta	N	Per	Gram		Coburn 1932	*Pleuraphis jamesii*
POACEAE	*Hilaria mutica*	(Buckl.) Benth.	tobosagrass	N	Per	Gram		Coburn 321, Coburn 1909	*Pleuraphis mutica*
POACEAE	*Hilaria rigida*	(Thurb.) Benth. ex Scribn.	big galleta	N	Per	Gram		Wright 92-1	*Pleuraphis rigida*
POACEAE	*Hopia obtusa*	(Kunth) Zuloaga &	vine mesquite	N	Per	Gram	FACU	Coburn 924, Coburn 1047	*Panicum obtusum*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
		Morrone							
POACEAE	*Hordeum arizonicum*	Covas	Arizona barley	N	Per	Gram	FAC	Coburn 187, Coburn 680	
POACEAE	*Hordeum jubatum*	L.	foxtail barley	N	Per	Gram		Reeder & Reeder 9585	
POACEAE	*Hordeum murinum*	L.	mouse barley	I	Ann	Gram	FACU	Coburn 664, Coburn 57	*Critesion murinum*
POACEAE	*Hordeum pusillum*	Nutt.	little barley	N	Ann	Gram	FACU	Coburn 144, Coburn 71	*Critesion pusillum, H. pusillum var. pubens*
POACEAE	*Koeleria pyramidata*	(Lam.) P.Beauv.	prairie Junegrass	N	Per	Gram		Coburn 182, 672	*Koeleria macrantha*
POACEAE	*Leersia oryzoides*	(L.) Sw.	rice cutgrass	N	Per	Gram	OBL	Coburn 1509	*Homalocenchrus oryzoides, Phalaris oryzoides*
POACEAE	*Leymus cinereus*	(Scribn. & Merr.) A. Löve	basin wildrye	N	Per	Gram	FAC	Coburn 781	*Aneurolepidium piperi, Elymus cinereus*
POACEAE	*Leymus triticoides*	(Buckl.) Pilger	beardless wildrye	N	Per	Gram	FAC	Coburn 257	*Elymus triticoides*
POACEAE	*Lolium pratense*	(Huds.) S.J. Darbyshire	meadow fescue	I	Per	Gram	FACU	Coburn 710	*Festuca elatior, Festuca pratensis, Schedonorus pratensis*
POACEAE	*Lycurus setosus*	(Nutt.) C.G. Reeder	bristly wolfstail	N	Per	Gram		Coburn 1303, Coburn 965	*Lycurus setosus, Pleopogon setosus*

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Monroa squarrosa*	(Nutt.) Torr.	false buffalograss	N	Ann	Gram		Coburn 1813	*Monroa squarrosa var. floccuosa*
POACEAE	*Muhlenbergia emersleyi*	Vasey	bullgrass	N	Per	Gram		Coburn 1950, Coburn 1435	
POACEAE	*Muhlenbergia fragilis*	Swallen	delicate muhly	N	Ann	Gram		Coburn 1362, Coburn 1089	
POACEAE	*Muhlenbergia porteri*	Scribn. ex Beal	bush muhly	N	Per	Gram		Coburn 454, Coburn 1447	
POACEAE	*Muhlenbergia rigens*	(Benth.) A.S. Hitchc.	deergrass	N	Per	Gram	FAC	Coburn 1535	*Epicampes rigens, Muhlenbergia marshii, M. mundula*
POACEAE	*Muhlenbergia tenuifolia*	(Kunth) Trin.	slender muhly	N	Ann	Gram		Coburn 1363	*Muhlenbergia monticola*
POACEAE	*Muhlenbergia torreyi*	(Kunth) A.S. Hitchc. ex Bush	ring muhly	N	Per	Gram		Coburn 1413, Coburn 1910	*Muhlenbergia gracillima*
POACEAE	*Panicum hallii*	Vasey	Hall's panicgrass	N	Per	Gram	UPL	Coburn 543, Coburn 1819	
POACEAE	*Panicum hirticaule*	J. Presl	Mexican panicgrass	N	Ann	Gram		Coburn 945, Coburn 1207	
POACEAE	*Panicum miliaceum*	L.	proso millet	I	Ann	Gram		Coburn 1948, Coburn 1286	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Panicum virgatum*	L.	switchgrass	N	Per	Gram	FACW	Coburn 369	*Many, see Tropicos*
POACEAE	*Pappostipa speciosa*	(Trin. & Rupr.) Romasch.	desert needlegrass	N	Per	Gram		Coburn 1558, Coburn 1755	*Achnatherum speciosum, Stipa speciosa*
POACEAE	*Pascopyrum smithii*	(Rydb.) Barkworth & D.R. Dewey	western wheatgrass	N	Per	Gram	FAC		*Agropyron smithii, Agropyron molle, Agropyron smithii var. palmeri, Elymus smithii*
POACEAE	*Paspalum dilatatum*	Poir.	dallisgrass	I	Per	Gram	FAC	Coburn 1417, Coburn 263	
POACEAE	*Paspalum distichum*	L.	knotgrass	N	Per	Gram	FACW	Coburn 282, Coburn 835	*Digitaria paspaloides, Paspalum distichum var. indutum, Paspalum paspaloides*
POACEAE	*Phalaris arundinacea*	L.	reed canarygrass	N	Per	Gram	FACW	Coburn 773, Coburn 223	*Phalaroides arundinacea*
POACEAE	*Phragmites australis subsp. americanus*	Saltonstall, P.M. Peterson & Soreng	American common reed	N	Per	Gram		Coburn 767	
POACEAE	*Poa compressa*	L.	Canada blue grass	I	Per	Gram	FACU	Coburn 79, Coburn 1793	*Paneion compressum*
POACEAE	*Poa fendleriana*	(Steud.) Vasey	muttongrass	N	Per	Gram		Coburn 56, Coburn 777	
POACEAE	*Poa pratensis*	L.	Kentucky bluegrass	I	Per	Gram	FAC	Coburn 140, Coburn 228	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POACEAE	*Polypogon interruptus*	Kunth	ditch rabbitsfoot grass	N	Per	Gram	FACW	Coburn 264, Coburn 92	*Polypogon lutosus, many others, see Tropicos*
POACEAE	*Polypogon monspeliensis*	(L.) Desf.	annual rabbitsfoot grass	I	Ann	Gram	FACW	Coburn 84	*Alopecurus monspeliensis*
POACEAE	*Polypogon viridis*	(Gouan) Breistr.	beardless rabbitsfoot grass	I	Per	Gram	FACW	Coburn 986, Coburn 226	*Agrostis semiverticillata, A. verticillata, A. viridis, Polypogon semiverticillatus*
POACEAE	*Schismus barbatus*	(Loefl. ex L.) Thell.	common Mediterranean grass	I	Ann	Gram		Coburn 1592	
POACEAE	*Scleropogon brevifolius*	Phil.	burrograss	N	Per	Gram		Coburn 1745, Coburn 1945	*Schleropogon longisetus*
POACEAE	*Setaria grisebachii*	Fourn.	Grisebach's bristlegrass	N	Ann	Gram		Coburn 1171 b, Coburn 365	
POACEAE	*Setaria leucopila*	(Scribn. & Merr.) K. Schum.	streambed bristlegrass	N	Per	Gram		Coburn 303, Coburn 449	*Chaetochloa leucophila*
POACEAE	*Setaria macrostachya*	Kunth	large-spike bristlegrass	N	Per	Gram		Coburn 420, Coburn 838	
POACEAE	*Setaria pumila*	(Poir.) Roemer & J.A. Schultes	yellow foxtail	I	Ann	Gram	FAC	Coburn 1259, Coburn 384	*Setaria lutesce*
POACEAE	*Setaria verticillata*	(L.) Beauv.	hooked bristlegrass	I	Ann	Gram	FACU	Coburn 1027	*Chaetochloa verticillata, Panicum verticillatum, Setaria carnei*

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POACEAE	*Setaria viridis*	(L.) Beauv.	green bristlegrass	I	Ann	Gram		Coburn 1223B, Coburn 1479	
POACEAE	*Sorghum bicolor*	(L.) Moench	sorghum	I	Ann	Gram	FACU	Coburn 1500	*Sorghum quineense, S. nervosum*
POACEAE	*Sorghum halepense*	(L.) Pers.	Johnsongrass	I	Per	Gram	FACU	Coburn 1528, Coburn 952	*Holcus halapensis, Sorghum miliaceum*
POACEAE	*Sporobolus airoides*	(Torr.) Torr.	alkali sacaton	N	Per	Gram	FAC	Coburn 422, Coburn 1424	*Agrostis airoides*
POACEAE	*Sporobolus contractus*	A.S. Hitchc.	spike dropseed	N	Per	Gram		Coburn 948, Coburn 1911	*Sporobolus cryptandrus var. strictus*
POACEAE	*Sporobolus cryptandrus*	(Torr.) A. Gray	sand dropseed	N	Per	Gram	FACU	Coburn 421, Coburn 1515	*Agrostis cryptandra, S. cryptandrus subsp. Fusicola*
POACEAE	*Thinopyrum ponticum*	(Podp.) Barkworth & D.R. Dewey	tall wheatgrass	I	Per	Gram		Coburn 1768	*Elymus elongatus, Thinopyrum elongatum subsp. ponticum, Lophopyrum elongatum*
POACEAE	*Tragus berteronianus*	J.A. Schultes	spiked bur grass	I	Ann	Gram		Coburn 1111, Coburn 1194	*Nazia aliena*
POACEAE	*Tridens muticus*	(Torr.) Nash	slim tridens	N	Per	Gram	FAC	Coburn 423, Coburn 1075	
POACEAE	*Urochloa arizonica*	(Scribn. & Merr.) O. Morrone & F. Zuloaga	Arizona signalgrass	N	Ann	Gram		Coburn 1243, Coburn 1928	*Brachiaria arizonica, Panicum arizonicum, Panicum arizonicum var. laeviglume*

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POACEAE	*Vulpia octoflora*	(Walt.) Rydb.	sixweeks fescue	N	Ann	Gram	UPL	Coburn 1564, Coburn 49	*Festuca octoflora*
POACEAE	*Zuloagaea bulbosa*	(Kunth) Bess	bulb panicgrass	N	Per	Gram	FAC	Coburn 1521	*Panicum bulbosum, P. bulbosum var. minor, P. plenum*
POLEMONIACEAE	*Allophyllum gilioides*	(Bentham) A.D. Grant & V.E. Grant	dense false gilyflower	N	Ann	Herb	FAC	Coburn 113, Coburn 43	*Gilia gilioides*
POLEMONIACEAE	*Eriastrum diffusum*	(A. Gray) Mason	miniature woollystar	N	Ann	Herb		Coburn 1689, Coburn 73	*Eriastrum diffusum subsp. jonesii*
POLEMONIACEAE	*Eriastrum eremicum*	(Jepson) Mason	desert woollystar	N	Ann	Herb		Coburn 1672, Coburn 74	
POLEMONIACEAE	*Gilia flavocincta*	A. Nels.	lesser yellowthroat gilia	N	Ann	Herb		Coburn 1563, Coburn 1674	
POLEMONIACEAE	*Gilia sinuata*	Dougl. ex Benth.	rosy gilia	N	Ann	Herb		Coburn 48, Coburn 564	*Gilia inconspicua var. sinuata*
POLEMONIACEAE	*Ipomopsis aggregata*	(Pursh) V. Grant	scarlet gilia	N	Per	Herb		Coburn 1498, Coburn 433a	
POLEMONIACEAE	*Ipomopsis longiflora*	(Torr.) V. Grant	flaxflowered ipomopsis	N	Ann	Herb		Coburn 1038, Coburn 1959	
POLEMONIACEAE	*Ipomopsis multiflora*	(Nutt.) V. Grant	manyflowered ipomopsis	N	Per	Herb		Coburn 1389, Coburn 879	*Gilia multiflora*

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POLEMONIACEAE	*Leptosiphon aureus*	(Nutt.) J.M. Porter & L.A. Johnson	golden linanthus	N	Ann	Herb		Coburn 44, Coburn 1686	
POLEMONIACEAE	*Linanthus bigelovii*	(A. Gray) Greene	Bigelow's linanthus	N	Ann	Herb		Coburn 568, Coburn 1662	*Gilia bigelovii*
POLEMONIACEAE	*Microsteris gracilis*	(Douglas ex Hook.) Greene	slender phlox	N	Ann	Herb		Coburn 1635, Coburn 566	*Phlox gracilis*
POLEMONIACEAE	*Phlox austromontana*	Coville	mountain phlox	N	Per	Subshrub		Coburn 646b	
POLEMONIACEAE	*Phlox longifolia*	Nutt.	longleaf phlox	N	Per	Herb		Coburn 651, Coburn 195	
POLYGALACEAE	*Polygala alba*	Nutt.	white milkwort	N	Per	Herb		Coburn 137, Coburn 758	*Polygala alba var. suspecta*
POLYGALACEAE	*Polygala barbeyana*	Chod.	blue milkwort	N	Per	Herb		Coburn 287, Coburn 1216	*Polygala longa*
POLYGALACEAE	*Polygala scoparioides*	Chod.	broom milkwort	N	Per	Herb		Coburn 488, Coburn 1940B	
POLYGALACEAE	*Rhinotropis rusbyi*	(Greene) J. R. Abbott	Rusby's milkwort	N	Per	Herb		Coburn 600	*Polygala rusbyi*
POLYGONACEAE	*Eriogonum abertianum*	Torr.	Abert's buckwheat	N	Ann	Herb		Coburn 106, Coburn 1430	

Family	Scientific Name	Author	Common Name	Native Status	Duration	Lifeform	Wetland Status	Collections	Synonyms
POLYGONACEAE	*Eriogonum alatum*	Torr.	winged buckwheat	N	Per	Herb		Coburn 1716	*Pterogonum alatum*
POLYGONACEAE	*Eriogonum deflexum*	Torr.	flatcrown buckwheat	N	Ann	Herb		Coburn 1937, Coburn 393	
POLYGONACEAE	*Eriogonum heermannii var. argense*	(M.E. Jones) Munz	Heermann's buckwheat	N	Per	Shrub		Coburn 412, Coburn 1361	*Eriogonum heermannii subsp. argense, Eriogonum howellii, Eriogonum sulcatum var. argense*
POLYGONACEAE	*Eriogonum microthecum var. simpsonii*	(Benth.) Reveal	slender buckwheat	N	Per	Shrub		Coburn 1903, Coburn 1543	
POLYGONACEAE	*Eriogonum palmerianum*	Reveal	Palmer's buckwheat	N	Ann	Herb		Coburn 273, Coburn 1810	*Eriogonum plumatella var. palmeri*
POLYGONACEAE	*Eriogonum polycladon*	Benth.	sorrel buckwheat	N	Ann	Herb		Coburn 396, Coburn 1182	*Eriogonum densum, E. vimineum var. densum*
POLYGONACEAE	*Eriogonum ripleyi*	J.T. Howell	Fraziers Well buckwheat	N	Per	Subshrub		Baker 11855	
POLYGONACEAE	*Eriogonum trichopes*	Torr.	little deserttrumpet	N	Ann	Herb		Coburn 853, Coburn 559	
POLYGONACEAE	*Eriogonum wrightii*	Torr. ex Benth.	bastardsage	N	Per	Subshrub		Coburn 1632, Coburn 939	
POLYGONACEAE	*Persicaria amphibia*	(L.) S.F. Gray p.p.	water smartweed	N	Per	Herb	OBL	Coburn 1529	*Persicaria amphibia var. emersa, P. coccinea, Polygonum coccineum*

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POLYGONACEAE	*Persicaria lapathifolia*	(L.) S.F. A. Gray	curlytop knotweed	N	Ann	Herb	FACW	Coburn 1260, Coburn 330b	*Polygonum lapathifolium, Polygonum incanum, Polygonum lapathifolium var. incanum*
POLYGONACEAE	*Persicaria punctata*	(Elliot) Small	dotted smartweed	N	Ann/Per	Herb	OBL	Coburn 1000	*Polygonum punctatum*
POLYGONACEAE	*Polygonum aviculare*	L.	prostrate knotweed	I	Ann	Herb	FACW	Coburn 119, Coburn 300	*Polygonum heterophyllum, Polygonum monspeliense, P. arenastrum, P. buxiforme*
POLYGONACEAE	*Rumex crispus*	L.	curly dock	I	Per	Herb	FAC	Coburn 185, Coburn 751	
POLYGONACEAE	*Rumex hymenosepalus*	Torr.	canaigre dock	N	Per	Herb		Coburn 1591	*Rumex hymenosepalus var. euhymenosepalus, R. hymenosepalus var. salinus*
POLYGONACEAE	*Rumex mexicanus*	Meisn.	Mexican dock	N	Per	Herb	FACW	Coburn 1395	
PORTULACACEAE	*Portulaca halimoides*	L.	silkcotton purslane	N	Ann	Herb	FAC	Coburn 1214, Coburn 380	*Portulaca parvula*
PORTULACACEAE	*Portulaca oleracea*	L.	little hogweed	I	Ann	Herb	FAC	Coburn 1211, Coburn 1057	*Portulaca neglecta*
PORTULACACEAE	*Portulaca suffrutescens*	Engelm.	shrubby purslane	N	Per	Herb		Coburn 970, Coburn 1299	*Portulaca neglecta, P. oleracea subsp. granulatostellulata, P. oleracea subsp. impolita, P. oleracea subsp. nicaraguensis, P. oleracea subsp. nitida, P. oleracea subsp. papillatostellulata, P. oleracea subsp. stellata, P. retusa*

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PORTULACACEAE	*Portulaca umbraticola*	Kunth	wingpod purslane	N	Ann	Herb	FACU	Coburn 1815, Coburn 917	
POTAMOGETONACEAE	*Potamogeton crispus*	L.	curly-leaved pondweed	I	Per	Herb	OBL	Baker 8542	
POTAMOGETONACEAE	*Potamogeton foliosus*	Raf.	leafy pondweed	N	Per	Herb	OBL	Baker 9629	*Numerous, see Tropicos*
POTAMOGETONACEAE	*Stuckenia filiformis*	(L.) Böerner	fineleaf pondweed	N	Per	Herb	OBL	Baker 12599	*Potamogeton filiformis, Coleogeton filiformis*
POTAMOGETONACEAE	*Stuckenia pectinata*	(L.) Böerner	sago pondweed	N	Per	Herb	OBL	Baker 8578	*Coleogeton pectinatus , Potamogeton pectinatus*
POTAMOGETONACEAE	*Zannichellia palustris*	L.	horned pondweed	N	Per	Herb	OBL	Coburn 1626	*Zannichellia major, Z. palustris var. major*
PRIMULACEAE	*Androsace occidentalis*	Pursh	western rockjasmine	N	Ann	Herb	FACU	Coburn 515	*Androsace arizonica, A. occidentalis var. arizonica, A. occidentalis var. simplex*
PRIMULACEAE	*Samolus valerandi*	L.	seaside brookweed	N	Per	Herb	OBL	Coburn 241, Coburn 1001B	*Samolus parviflorus, Samolus valerandi subsp. parviflorus*
PTERIDACEAE	*Adiantum capillus-veneris*	L.	common maidenhair	N	Per	Fern	FACW	Baker 9644	*Adiantum capillus-veneris var. modestum, A. capillus-veneris var. protrusum, A. modestum*
PTERIDACEAE	*Astrolepis integerrima*	(Hook.) Benham & Windham	hybrid cloakfern	N	Per	Fern		Coburn 1666, Coburn 328a	*Cheilanthes integerrma, Notholaena integerrima, N. sinuata var. integerrima*
PTERIDACEAE	*Cheilanthes eatonii*	Baker	Eaton's lipfern	N	Per	Fern		Coburn 1096	*Cheilanthes castanea, C. eatonii var. castenea*

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PTERIDACEAE	*Cheilanthes feei*	T. Moore	slender lipfern	N	Per	Fern		Coburn 1448, Coburn 529	
PTERIDACEAE	*Cheilanthes fendleri*	Hook.	Fendler's lipfern	N	Per	Fern		Coburn 973	
PTERIDACEAE	*Cheilanthes wootonii*	Maxon	beaded lipfern	N	Per	Fern		Coburn 1407	
PTERIDACEAE	*Pellaea truncata*	Goodding	spiny cliffbrake	N	Per	Fern		Coburn 1169	*Pellaea longimucronata*
RANUNCULACEAE	*Anemone tuberosa*	Rydb.	tuber anemone	N	Per	Herb		Coburn 498, Coburn 1639	
RANUNCULACEAE	*Aquilegia chrysantha*	A. Gray	golden columbine	N	Per	Herb	FAC	Coburn 265	
RANUNCULACEAE	*Ceratocephala testiculata*	(Crantz) Besser	curveseed butterwort	N	Ann	Herb		Coburn 527	*Ranunculus testiculata*
RANUNCULACEAE	*Clematis ligusticifolia*	Nutt.	western white clematis	N	Per	Vine	FAC	Coburn 1185	*C. neomexicana, C. suksdorfii*
RANUNCULACEAE	*Delphinium scaposum*	Greene	tall mountain larkspur	N	Per	Herb		Coburn 598, Coburn 194	*D. andersonii var. scaposum*
RANUNCULACEAE	*Myosurus cupulatus*	S. Wats.	Arizona mousetail	N	Ann	Herb	FAC	Coburn 1637, Coburn 508	
RANUNCULACEAE	*Ranunculus cymbalaria*	Pursh	alkali buttercup	N	Per	Herb	OBL	Coburn 814, Coburn 161	*Numerous, see Tropicos*

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RANUNCULACEAE	*Thalictrum fendleri*	Engelm. ex A. Gray	Fendler's meadow-rue	N	Per	Herb	FAC	Coburn 1411, Coburn 1248	*Thalictrum amissum, T. fendleri var. platycarpum, T. fendleri var. wrightii*
RHAMNACEAE	*Ceanothus greggii*	A. Gray	desert ceanothus	N	Per	Shrub		Coburn 499, Coburn 1718	
RHAMNACEAE	*Frangula californica*	(Eschsch.) A. Gray	California buckthorn	N	Per	Tree	FACW	Coburn 686, Coburn 866	*Rhamnus californica*
RHAMNACEAE	*Rhamnus ilicifolia*	Kellogg	hollyleaf redberry	N	Per	Shrub		Coburn 317, Coburn 699	*Rhamnus crocea subsp. ilicifolia, R. crocea var. ilicifolia*
RHAMNACEAE	*Ziziphus obtusifolia*	(Hook. ex Torr. & A. Gray) A. Gray	lotebush	N	Per	Tree		Coburn 83, Coburn 667	
ROSACEAE	*Amelanchier utahensis*	Koehne	Utah serviceberry	N	Per	Tree	FACU	Coburn 1306, Coburn 538	
ROSACEAE	*Cercocarpus montanus*	Raf.	alderleaf mountain mahogany	N	Per	Shrub		Coburn 1741, Coburn 817	*Cercocarpus glaberoides*
ROSACEAE	*Chamaebatiaria millefolium*	(Torr.) Maxim.	fern bush, desert sweet	N	Per	Shrub		Coburn 531, Coburn 1358	
ROSACEAE	*Fallugia paradoxa*	(D. Don) Endl. ex Torr.	Apache plume	N	Per	Shrub		Coburn 1954, Coburn 306	
ROSACEAE	*Petrophytum caespitosum*	(Nutt.) Rydb.	mat rockspirea	N	Per	Subshrub		Coburn 1504	

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ROSACEAE	*Potentilla biennis*	Greene	biennial cinquefoil	N	Ann/Bien	Herb	FACW	Coburn 341b	
ROSACEAE	*Purshia stansburiana*	(Torr.) Henricks on	Stansbury cliffrose	N	Per	Shrub		Coburn 1210, 1400	
ROSACEAE	*Pyrus communis*	L.	common pear	I	Per	Tree		Coburn 506b	
ROSACEAE	*Rosa woodsii*	Lindl.	Woods' rose	N	Per	Shrub	FACU	Coburn 1739, Coburn 1520	
ROSACEAE	*Rubus discolor*	Weihe & Nees	Himalayan blackberry	I	Per	Subshrub	FACU	Baker 9329	
RUBIACEAE	*Galium aparine*	L.	stickywilly	N	Ann	Herb	FACU	Coburn 38, Coburn 1725	*Numerous, see Tropicos*
RUBIACEAE	*Galium microphyllum*	A. Gray	bracted bedstraw	N	Per	Herb	FACU	Coburn 149, Coburn 112	*Relbunium microphyllum*
RUBIACEAE	*Galium proliferum*	A. Gray	limestone bedstraw	N	Ann	Herb		Coburn 1660B, Baker 8981	*Galium proliferum var. subnudum, G. virgatum var. diffusum*
RUBIACEAE	*Galium wrightii*	A. Gray	Wright's bedstraw	N	Per	Subshrub		Coburn 1446, Coburn 955	*Galium frankliniense, G. rothrockii, G. wrightii var. rothrockii*
RUBIACEAE	*Houstonia rubra*	Cav.	red bluet	N	Per	Herb		Coburn 601, Coburn 1806	*Hedyotis rubra, Oldenlandia rubra*
RUTACEAE	*Ptelea trifoliata*	L.	common hoptree	N	Per	Tree	UPL	Coburn 219a, Coburn1503	

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RUTACEAE	*Thamnosma texanum*	(A. Gray) Torr.	rue of the mountains	N	Per	Herb/Sub		Coburn 536, Coburn 316, Coburn 718	*Thamnosma texana*
SALICACEAE	*Populus fremontii*	S. Wats.	Fremont cottonwood	N	Per	Tree		Coburn 1658	
SALICACEAE	*Salix exigua*	Nutt.	narrowleaf willow	N	Per	Shrub	FACW	Coburn 201, Coburn 1774	*Salix argophylla, Salix exigua var. angustissima*
SALICACEAE	*Salix gooddingii*	Ball	Goodding's willow	N	Per	Tree	FACW	Coburn 1589, Coburn 200	*Salix gooddingii var. vallicola, Salix nigra var. vallicola, Salix vallicola*
SALICACEAE	*Salix laevigata*	Bebb	red willow	N	Per	Tree	FACW	Coburn 294	*Salix bonplandiana var. laevigata, Salix congesta, Salix laevigata var. angustifolia*
SANTALACEAE	*Comandra umbellata*	(L.) Nutt.	bastard toadflax	N	Per	Herb/Sub	UPL	Coburn 1757	
SANTALACEAE	*Phoradendron capitellatum*	Torr. ex Trel.	downy mistletoe	N	Per	Subshrub		Licher 3752	
SAPINDACEAE	*Acer negundo*	L.	boxelder	N	Per	Tree	FACW	Coburn 512b, Coburn 96	
SAPINDACEAE	*Sapindus saponaria*	L.	wingleaf soapberry	N	Per	Tree	FACU	Coburn 802, Coburn 1788	
SAURURACEAE	*Anemopsis californica*	(Nutt.) Hook. & Arn.	yerba mansa	N	Per	Herb	OBL	Coburn 98, Coburn 1468b	*Anemopsis californica var. subglabra*
SCROPHULARIACEAE	*Verbascum thapsus*	L.	common mullein	I	Bien	Herb	FACU	Coburn 1785b	

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SIMAROUBACEAE	*Ailanthus altissima*	(P. Mill.) Swingle	tree of heaven	I	Per	Tree	FACU	Coburn 1033, Coburn 857	*Ailanthus glandulosa*
SOLANACEAE	*Calibrachoa parviflora*	(Juss.) D'Arcy	seaside petunia	N	Ann	Herb	FACW	Coburn 1468, Coburn 301	*Petunia parviflora*
SOLANACEAE	*Chamaesaracha coronopus*	(Dunal) A. Gray	greenleaf five eyes	N	Per	Herb		Coburn 330a, Coburn 915	*Chamaesaracha coronopus var. arida*
SOLANACEAE	*Datura wrightii*	Regel	sacred thorn-apple	N	Per	Herb	UPL	Coburn 331b	*Datura inoxia subsp. quinquecuspida, D. metel var. quinquecuspida, D. meteloides*
SOLANACEAE	*Lycium andersonii*	A. Gray	water jacket	N	Per	Shrub		Coburn 836	
SOLANACEAE	*Lycium exsertum*	A. Gray	Arizona desert-thorn	N	Per	Shrub		Coburn 482	
SOLANACEAE	*Lycium pallidum*	Miers	pale desert-thorn	N	Per	Shrub		Coburn 1628, Coburn 610	
SOLANACEAE	*Nicotiana obtusifolia*	Mertens & Galeotti	desert tobacco	N	Per	Herb	FACU	Coburn 1459, Coburn 302	*Nicotiana trigonophylla*
SOLANACEAE	*Physalis hederifolia var. fendleri*	(A. Gray) Cronq.	Fendler's groundcherry	N	Per	Herb		Coburn 1930, Coburn 719	*Physalis fendleri, P. fendleri var. cordifolia, P. hederifolia var. cordifolia*
SOLANACEAE	*Physalis hederifolia var.hederifolia*	A. Gray	ivyleaf groundcherry	N	Per	Herb		Coburn 735, Coburn 1495	
SOLANACEAE	*Physalis neomexicana*	Rydb.	New Mexican groundcherry	N	Ann	Herb		Coburn 943, 1178, 1349	*Physalis subulata var. neomexicana, Physalis foetens var. neomexicana*

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SOLANACEAE	*Physalis solanacea*	(Schltdl.) Axelius	netted globecherry	N	Ann	Herb		Coburn 1062	
SOLANACEAE	*Solanum americanum*	P. Mill.	American black nightshade	N	Ann/Per	Herb	FACU	Coburn 1449, Coburn 466	*S. linnaeanum, S. nigrum var. americanum, S. nigrum var. virginicum, S. nodiflorum*
SOLANACEAE	*Solanum douglasii*	Dunal	greenspot nightshade	N	Per	Herb	FAC	Coburn 1349b	*Solanum nigrum var. douglasii*
SOLANACEAE	*Solanum elaeagnifolium*	Cav.	silverleaf nightshade	N	Per	Herb		Coburn 338b, Coburn 837	
SOLANACEAE	*Solanum rostratum*	Dunal	buffalobur nightshade	N	Ann	Herb		Coburn 1229, Coburn 307	*Androcera rostrata, Solanum cornutum*
TAMARICACEAE	*Tamarix chinensis*	Lour.	five-stamen tamarisk	I	Per	Tree	FAC	Coburn 272, Coburn 798	*Tamarix pentandra*
TYPHACEAE	*Typha domingensis*	Pers.	southern cattail	N	Per	Herb	OBL	Coburn 791, Coburn 1020	*Typha angustata*
ULMACEAE	*Ulmus parvifolia*	Jacq.	Chinese elm	N	Per	Tree	UPL	Coburn 827, Coburn 1519	*Ulmus chinensis*
URTICACEAE	*Parietaria hespera*	Hinton	rillita pellitory	N	Ann	Herb	FACU	Coburn 42, Coburn 698	
URTICACEAE	*Urtica dioica subsp. gracilis*	(Ait.) Seland.	stinging nettle	N	Per	Herb	FAC	Coburn 1037	
VERBENACEAE	*Aloysia wrightii*	Heller ex Abrams	Wright's beebrush	N	Per	Shrub		Coburn 443, Coburn 1191	*Lippia wrightii*

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VERBENACEAE	*Glandularia bipinnatifida*	(Nutt.) Nutt.	Dakota mock vervain	N	Per	Herb		Coburn 998	*Verbena ambrosiifolia, V. bipinnitifida, V. bipinnatifida var. brevispicata*
VERBENACEAE	*Glandularia gooddingii*	(Briq.) Solbrig	southwestern mock vervain	N	Per	Herb		Coburn 1441, Coburn 204	*Verbena arizonica, V. gooddingii, V. gooddingii var. nepetifolia, V. verna, V. var. fissa*
VERBENACEAE	*Phyla cuneifolia*	(Torr.) Greene	wedgeleaf	N	Per	Subshrub	FAC	Coburn 1787, Coburn 154	*Zapania cuneifolia, Lippia cuneifolia, Lippia cuneifolia var. incisa*
VERBENACEAE	*Verbena bracteata*	Lag. & Rodr.	bigbract verbena	N	Per	Herb	FAC	Coburn 151, Coburn 93	
VERBENACEAE	*Verbena neomexicana*	(A. Gray) Small	hillside vervain	N	Per	Herb		Coburn 128, Coburn 636, Coburn 979	
VIOLACEAE	*Hybanthus verticillatus*	(Ortega) Baill.	babyslippers	N	Per	Herb		Coburn 612, Coburn 269	
VIOLACEAE	*Viola nephrophylla*	Greene	northern bog violet	N	Per	Herb	FACW	Coburn 495	
VITACEAE	*Parthenocissus quinquefolia*	(L.) Planch.	Virginia creeper	N	Per	Vine	FAC	Coburn 741	*Numerous, see Tropicos*
VITACEAE	*Parthenocissus vitacea*	(Knerr) A.S. Hitchc.	woodbine	N	Per	Vine	FAC	Coburn 790	*Parthenocissus inserta*
VITACEAE	*Vitis arizonica*	Engelm.	canyon grape	N	Per	Vine	FACU	Coburn 1195	*Vitis arizonica var. galvinii, V. arizonica var. glabra, V. treleasei*
ZYGOPHYLLACEAE	*Kallstroemia californica*	(S. Wats.) Vail	California caltrop	N	Ann	Herb		Coburn 1917	*Kallstroemia brachystylis, K. californica var. brachystylis*

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ZYGOPHYLLACEAE	*Kallstroemia grandiflora*	Torr. ex A. Gray	Arizona poppy	N	Ann	Herb		Coburn 1927B	
ZYGOPHYLLACEAE	*Kallstroemia parviflora*	J.B.S. Norton	warty caltrop	N	Ann	Herb		Coburn 846, Coburn 1198	*Kallstroemia intermedia*
ZYGOPHYLLACEAE	*Larrea tridentata*	(Sessé & Moc. ex DC.) Coville	creosote bush	N	Per	Shrub		Coburn 1215	*Larrea mexicana*
ZYGOPHYLLACEAE	*Tribulus terrestris*	L.	puncture vine	I	Ann	Herb		Coburn 833, Coburn 1129	