Vascular Plants of the Whipple Mountains

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VASCULAR PLANTS OF THE WHIPLLE MOUNTAINS

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ABSTRACT

The Sonoran and Mojave deserts meet just north of the Whipple Mountains, which are situated in southeast San Bernardino County, California, along the Colorado River and adjacent to Arizona. Vegetation from the Pleistocene to the present was inferred from previously published packrat midden data and the current floristic composition. Climate data suggest that summer rainfall is a factor underlying the vegetational differences between the western and eastern portions of the Sonoran desert. Plant collections in the area yielded primarily California Sonoran plants, but also several Mojave and Arizona Sonoran plants. A fair number of the Arizona Sonoran plants collected were on the western margins of their ranges. Three species new to California’s flora were documented in this study: Berberis harrisoniana, Delphinium scaposum, and Erigeron oxyphyllus.

Key words: Arizona, biogeography, California, Colorado River, flora, midden, San Bernardino County, Sonoran Desert, vegetation, Whipple Mountains.

INTRODUCTION

Home to California’s largest population of saguaro cactus (Carnegiea gigantea (Engelm.) Britton & Rose), the Whipple Mountains are located in southeast San Bernardino County, the eastern-most portion of California, and bordered on the east by the Colorado River (Brum 1973). The nearest services are available in Parker, Arizona, just across the river and southwest of the mountain range. Lake Havasu City is about 56 km (35 mi) north of Parker, across Lake Havasu from the town of Havasu Lake, California, which is just north of the study site. Lake Havasu is held by Parker Dam, which spans the Colorado River just south of Bill Williams River, 21 km (13 mi) north of Parker, and 23 km (14 mi) south of Lake Havasu City. There are only two main paved roads near the Whipple Mountains, California State Highway 62 which runs through the southern bajada between Vidal Junction and Parker, and US Highway 95 which joins Blythe and Needles, passing through Vidal and Vidal Junction (Fig. 1).

The mountains are situated in the Lower Colorado River Valley, in the northern limit of the Sonoran Desert, with the Mojave Desert immediately north of the mountains (Shreve 1964; Cronquist 1982; McLaughlin 1989, 1995). Shreve (1964) observed floristic differences between the eastern and western portions of the Sonoran Desert. Generally, it seems that some common plants in Arizona do not occur west of the Colorado River. To highlight these floristic distinctions, the east and west portions of the Sonoran Desert will be referred to as the Arizona and California Sonoran Desert, respectively.

Given the proximity of the Mojave and Arizona Sonoran floristic elements, it is no surprise that some plants generally restricted to the Mojave or Arizona Sonoran deserts also occur in the study area, along with Colorado Desert plants. The Sonoran Desert as a whole has a rich flora of nearly 2600 species, 30% of which are endemic (Wells and Hunziker 1976). In spite of this unique biogeographic situation, little botanical exploration of the Whipple Mountains had been done beyond roadside collecting.

The study area encompasses about 129,500 hectares (320,000 acres; 500 square miles), including the Whipple Mountains Wilderness (administered by the Bureau of Land Management [BLM]), bajada and creosote flats around the mountains. The boundaries are placed approximately along watersheds, with Chemehuevi Wash forming the northern boundary and the Colorado River delimiting the eastern boundary. US Highway 95, the western boundary, roughly follows the drainages between the Turtle and Whipple ranges. The southern boundary traces Vidal Wash between US Highway 95 and the Colorado River. This wash empties into the river just south of the San Bernardino-Riverside county line (Fig. 1, 2). The study site spans 34°04’45” to 34°28’22”N and 114°07’48” to 114°39’17”W.

Most of area is managed by the Bureau of Land Management (BLM). Portions are also administered by the Colorado River Indian Tribes (CRIT), the Chemehuevi Indian Tribe, and the Metropolitan Water District of Southern California (MWD; Fig. 1).

The main obstacle to thoroughly covering the site is the rugged BLM Wilderness area in the center of the mountains, which covers 31,372 hectares (77,520 acres; 121 square miles), about one-fourth of the total area. No motor vehicles are permitted in this area, al-
through several abandoned mining roads lead into the area and can be followed on foot. Vehicle-accessible roads do run along the periphery of the Wilderness area, however, and the bajadas and creosote flats have a wide network of roads and trails. Providing access on the eastern side is Parker Dam Road, MWD/Black Meadow Landing Road, Havasu Palms Road, and a powerline road administered by MWD. Highway access is provided by California State Highway 62, south of the mountains, and US Highway 95 on the western boundary of the study site.

**PHYSICAL SETTING**

*Topography*

Elevations range from around 102 to 1259 m (335 to 4131 ft), and habitats include windblown ridges, riparian zones, creosote bush bajadas and rocky canyons (Fig. 3–9). The eastern portion of the range contains spectacular volcanic rock bluffs with sheer sides over 40 m (130 ft) high. Ridges at higher elevations farther west are steep and blanketed with loose pieces of granite and gneiss from crumbling outcrops (Fig. 5). The highest elevation is 1259 m (4131 ft), along a ridge on the northwest side of the mountains (34°18’52”N, 114°24’37”W). Savahia Peak, a dark volcanic knife-edge promontory at the western end of the mountains (34°16’33”N, 114°31’56”W), is just over 800 m (2700 ft; Fig. 6).

Perhaps the most fascinating point of physiographic interest in the site is Monument Peak (34°16’51”N, 114°15’15”W, Fig. 3). This short spire reaches only 748 m (2450 ft) in elevation, yet due to its location it forms a magnificent silhouette against the sky and can...
be seen for miles from south of the mountains (see Ives 1861). It marks the northern corner of the Colorado River Indian Reservation.

The Colorado River is a primary drainage for the Colorado Plateau and the Sonoran Desert. The lowest elevation in the site, 102 m (335 ft), is found along the Colorado River at the south end of the study area, where Vidal Wash joins the Colorado, just below the San Bernardino-Riverside county line (34°04'45"N, 114°26'05"W). Vidal Wash drains the southeast side of the Turtle Mountains and southern slopes of the Whipple Mountains. Chemehuevi Wash, which drains not only the north slopes of the Whipple Mountains, but also the Chemehuevi Mountains, Stepladder Mountains, and the northern part of the Turtle Mountains, flows into the Colorado just south of the town of Havasu Lake (34°28'22"N, 114°24'20"W).

Several washes drain directly from the Whipple Mountains into the Colorado River. These include Bennett Wash (confluence near Bass Point), Bowman’s Wash (near the former town site of Crossroads), Copper Basin Wash (near Echo Point), Black Metal Wash (following Black Meadow Landing Road), Whipple Wash (empties just south of Havasu Palms), and Copper Canyon (mostly on the Chemehuevi Indian Reservation). Whipple Wash is the largest of these drainages and has its head near the Mountains’ highest peak, at about 1050 m (3450 ft) elevation.

Climate

The Whipple Mountains experience a temperate, warm desert environment, typical of the Lower Colorado River Valley. The average temperature ranges
from 5°C (41°F) in January to 42°C (108°F) in July, as recorded at Parker, Arizona (Fig. 10; Rowlands 1995a). The record high at Parker was 53°C (127°F, in 1905) and the record low was −12°C (10°F, in 1894; from www.weather.com).

Average precipitation is 119.5 mm (4.70 in) per year, with rain from both winter storms and summer monsoons. The monsoons, which occur between June and October, contribute about 36% of the annual rainfall (Fig. 11; see also Van Devender 1990; Van Devender et al. 1990; Rowlands 1995a). The warm phase of El Niño/Southern Oscillation may increase summer rainfall (Higgins et al. 2002). Chubascos, or tropical storms that form off of Mexico's west coast, occasionally reach the California deserts in August or September, where they can cause severe flash flooding (Rowlands 1995a). Twenty-year running averages for Parker, Buckeye, and Indio indicate little change in precipitation over the past 90 years (De Groot 2004).

Geology

The bulk of the mountains is composed of Precambrian rock, probably nearly two billion years old (Fig. 12; Bishop 1964; Norris 1995). The gneiss-like formations at higher elevations may be around this age (Norris 1995). At least some of these rocks probably were deposited first as marine sedimentary rocks of a Cordilleran geocline, and later were subjected to metamorphism and intrusion by granitic magmas (Norris 1995).

During the Miocene (25–8 million years ago [mya]), the Lower Colorado River Valley was subjected to geothermal heating, while at the same time the Pacific plate drifted northwest. The lower layers of the Earth’s crust stretched, but the surface cracked, forming several detachment faults in and around the Whipple Mountains (Fig. 12; Norris 1995; Scarborough 2000). The core of the mountains was probably at least partly fluid at this time (see also Scarborough 2000). The reddish Tertiary volcanic rock composing the eastern bluffs and various prominent points around the mountains was laid down at about this time (Fig. 12; Blake 1856; Bishop 1964; Norris 1995; Scarborough 2000).

Copper ore may be found in the mountains, today primarily in old mine tailings. Gold, silver, and manganese ores were also present, but to a lesser extent (Bishop 1964; Vredenburgh et al. 1981). These ore deposits were probably from intrusions, occurring perhaps during the Mesozoic (Norris 1995).

Soils near the river and in the plains around the range are composed of Quaternary alluvium or Pleistocene non-marine rocks (Fig. 12; Marcou 1856). On the eastern side of the mountains there are some Tertiary non-marine deposits, which probably include the red sandstones around lower Bowman’s Wash (Bishop 1964). Flats along the river may have alkaline soils, often with salt deposits on the surface. Washes flow over beds of coarse sand, between boulders, or over exposed bedrock. On the higher slopes, soils are generally thin, rocky, and lack organic material.

Near the Colorado River, there are several small systems of stabilized sand dunes. It appears that there is little aeolian activity in these dune systems since vegetation covers most of the surface (Bowers 1986; Whitford 2002). The river was undoubtedly the sand source for these dunes. However, many dams now impede sediment transport downstream, and without this sand source dune building progresses imperceptibly or has stopped (Clarke and Rendell 1998).

Occasionally, microphytic crusts may be encountered. These are aggregations of cyanobacteria, lichens, algae, liverworts, or mosses that form stabilizing crusts over soil surfaces (McAuliffe 2000). These organisms are active only a few days following a rain before lapsing back into dormancy (McAuliffe 2000). One feature of note is desert pavement, which is common in the bajadas and plains around the mountains. Removal of fine particles by wind is one of the oldest theories; however, evidence of its occurrence is
rare, and instead fine particles may be removed by water runoff (Cooke 1970). This is plausible since desert pavement soils are usually quite impervious to water (Musick 1975). Cooke (1970) postulated that pavements were originally formed by runoff and by cycles of wetting and drying, which pushed coarser particles upwards. Today, pavements are subjected to creep, runoff, and superficial disintegration, which cause few changes to the established mosaic. Creep occurs when pavement soils are saturated, and particles may shift or slide slightly. Superficial disintegration includes weathering processes of heat/cold cycles, freeze/thaw cycles, and salt weathering (Cooke 1970).

Desert varnish (or rock varnish) is another prominent geologic feature. According to Armstrong (1997) and McAuliffe (2000), bacteria that live on rock surfaces get energy from oxidizing manganese and iron that occur in the rock. These manganese and iron oxides mix with clay minerals to form blackish (manganese oxide) or reddish (iron oxide) coatings over rocks. Since these coatings are laid down slowly, they have been used in dating of landforms and artifacts in the desert (Cooke 1970; Armstrong 1997; McAuliffe 2000).

**HISTORY**

**General Human History**

At the time of European contact, much of the land along the Colorado River near the Whipple Mountains was occupied by the Chemehuevi Tribe (Ives 1861). They raised crops of grain and vegetables, and also hunted (Whipple 1856; Whipple et al. 1856). Mojave Indians also resided in the Colorado Valley and raised corn, beans, wheat, squash, peas, and other crops (Whipple 1856).

Juan de Oñate was perhaps the first European to pass by the Whipple Mountains, when he explored in western Arizona and along the Colorado River in 1604 (Huachuca History Program; Gudde 1998). In 1776, Friar Francisco Garcés traveled up the Colorado River from the confluence with the Gila River to the junction with the Mojave River (near present-day Needles) and later returned along the same route (Beck and Hasse 1974). Mountain men James Ohio Pattie and Peter Skene Ogden also traveled along the Colorado River between Needles and Yuma in 1826 and 1829–1830, respectively (Beck and Hasse 1974). In the fall of 1851, Brevet Captain Lorenzo Sitgreaves of the US Army Corps of Topographical En-
engineers led an overland expedition from Santa Fé down the Zuñi and Colorado rivers to Yuma. They reached the Colorado above the Bill Williams River (near present-day Parker Dam; Kern 1852). The report did not specifically refer to the Whipple Mountains, but described the Colorado River Valley as dry and weedy, “the most perfect picture of desolation” (Sitgreaves 1854: 18).

Lieutenant Amiel Weeks Whipple, of the Corps of Topographical Engineers and the mountains’ namesake, passed by the area in 1854 while surveying for a route for a railroad, roughly following the 35th parallel. The expedition struck the Colorado River at its confluence with Bill Williams River, then continued upstream to the Needles area before heading west (Whipple 1856; Ives 1861; Durham 1998). Whipple described the range as “a pile of black mountains... upon both sides” of the Colorado River (Whipple 1856: 109).

First Lieutenant Joseph Christmas Ives, also of the Topographical Engineers, had accompanied Whipple in 1853–1854 (Whipple 1856). He led a steamboat expedition in 1857 and 1858 up the Colorado River from Yuma to Las Vegas, and further explored the Grand Canyon area on foot (Ives 1861). About the Grand Canyon, Ives wrote:

The region last explored is, of course, altogether valueless. It can be approached only from the south, and after entering it there is nothing to do but leave. Ours has been the first, and will undoubtedly be the last, party of whites to visit this profitless locality. It seems intended by nature that the Colorado River, along the greater portion of its lonely and majestic way, shall be forever unvisited and undisturbed (Ives 1861: 110).

In contrast, when Ives was approaching the Whipple Mountains, he wrote:

We are now at the verge of the foot-hills of a continuous chain of mountains, that crosses the Colorado ten miles above, and has been in sight for many days. Among the group of fantastic peaks that surround the chain is a slender and perfectly symmetrical spire that furnishes a striking landmark, as it can be seen from a great way down the river in beautiful relief against the sky (Ives 1861: 55).

The Whipple Mountains, together with the Buckskin Mountains across the Colorado River, are referred to as the Monument Mountains in the report and map. Ives gave the name Mount Whipple to “a high peak” of the mountains, visible from the north side (Ives 1861: 60; probably the butte at 34°20'46"N, 114°19'30"W). The name Whipple Mountains was first applied to the range on the USGS Parker quadrangle of 1902–1903 (Gudde 1998).

The Atchison, Topeka & Santa Fe Railroad runs along the south side of the mountains, and arrived in Parker around 1910 (Vredenburgh et al. 1981).

Remnants of mines can be found throughout the mountains. Many of these were active between 1880 and 1920 (Vredenburgh et al. 1981; Sheridan 2000). Copper ore was the primary product, but gold, silver, and manganese ores were also found (Bishop 1964; Preston 1974; Vredenburgh et al. 1981; Sheridan 2000). Vredenburgh et al. (1981) suggest that soldiers stationed along the river probably discovered the first veins, and some mining began as early as 1862, mostly in Copper Basin or the area of Havasu Palms. The Black Metal Silver Mine near Black Metal [Meadow?] Landing began operation around 1879, worked by Pete McGuire and the Levi brothers. Just to the north, John S. Jennings pulled gold ore from the Klondike Mine between 1897 and 1911. In Copper Basin, the Grand Central and Copper Basin mines began operation around 1881, producing both copper and silver ores. During both World Wars, several mines near Monument Peak produced manganese ores. The American Eagle Mine, in the western part of the mountains, was active between 1875 and 1919, employing up to five men and having a shaft 300 feet deep by 1908. Nearby, the D&W mine, named for its discoverers, Dayton and Wilbur, employed three shifts of men at times, boasted a 700-foot deep shaft, and had water available on the third level. It was active only between 1906 and 1916, and usually closed between June and September due to heat (Vredenburgh et al. 1981).

One prominent resident of the area was Wyatt Earp. He and his wife, Josephine, lived in Parker, Calzona (near today’s Big River), and Vidal between 1905 and 1928 (Boyer 1976; Reidhead 2002). Earp filed about 100 claims, probably in the southern part of the Whipple Mountains, under the name Happy Day Mining Company (Boyer 1976). He found enough gold and copper to earn a living by prospecting, at one point having a shaft 100 feet deep (Boyer 1976; Vredenburgh et al. 1981). He also kept a cabin in Drennan, now called Earp in his honor, across the river from Parker (Durham 1998; Reidhead 2002).

The Colorado River Indian Reservation was established on 3 March 1865 (Okimoto 2001). It covers over 97,125 hectares (240,000 acres; 375 square miles) of land in the Colorado Valley. Primary tribes represented are the Mojave, Chemehuevi, Hopi, and Navajo. Headgate Rock Dam, completed in 1941, allows for the diversion of water into the valley for irrigation (Okimoto 2001). A large portion of the reservation’s present income is from agriculture (Charles Land pers. comm.).

The Colorado River Project was approved in 1931. Crossroads became a boomtown of 2000–3000 people in the 1930s during the construction of Parker Dam (Schweich 2004). The 98 m (320 ft)-tall dam was completed in 1938 and includes four hydroelectric generators. When finished, Lake Havasu formed behind Parker Dam. Its name was given when a Mojave Indian chief used the words “ahá havasú,” or blue wa-
Table 1. Botanical collectors in the Whipple Mountains area, based on herbarium specimens from RSA-POM, CAS/DS, UC/JEPS, UCR, and ARIZ.

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<th>Year</th>
<th>Collector(s)</th>
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<td>W. L. Jepson</td>
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<td>1915</td>
<td>F. Shreve</td>
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<tr>
<td>1918</td>
<td>R. S. Ferris</td>
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<tr>
<td>1920</td>
<td>P. A. Munz &amp; R. D. Harwood</td>
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<td>1932</td>
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<td>1932</td>
<td>R. S. Ferris &amp; R. Bacigalupi</td>
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<td>1934</td>
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<td>1937</td>
<td>R. M. Perkins &amp; H. de Forest</td>
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<td>J. M. Porter</td>
</tr>
<tr>
<td>2003</td>
<td>S. J. De Groot et al.</td>
</tr>
<tr>
<td>2004</td>
<td>S. J. De Groot et al.</td>
</tr>
</tbody>
</table>

Table 1. Continued.

The 242-mile Colorado River Aqueduct, administered by the Metropolitan Water District of Southern California, was completed in 1941 and brings water to Lake Mathews (near Temecula/Perris) and San Vicente Reservoir (near San Diego; Beck and Hasse 1974; Mount 1995). Water is pumped from Whitset Intake, at 139 m (455 ft) elevation just upstream from Parker Dam, through the Colorado River Tunnel into Gene Reservoir, about 2.4 km (1.5 mi) west of Parker Dam. From here, it passes through Gene Pumping Station and the Copper Basin Tunnel to Copper Basin Reservoir, a few miles further west, at 313 m (1028 ft). In total the water is raised 175 m (573 ft). After flowing through the Whipple Mountain Tunnel to the west portal on the southeast side of the mountains, the water...
flows by gravity about 97 km (60 mi) to Iron Mountain Pumping Station, at 274 m (900 ft) elevation.

Botanical Collectors

Herbarium specimens (743 collections, prior to this study) indicate that several botanists made a number of collections in the Whipple Mountains, but no collector systematically explored the entire area (Table 1). The earliest collections were made along the Colorado River, by J. Grinnell in 1910 and Willis Linn Jepson in 1912. Carl Wolf traveled between 1 and 20 February, along the Bill Williams River, where the expedition did not camped along the Colorado near the mouth of the Bill Williams River on 20 February, the expedition did not cross the Colorado River into California until 27 February, near present-day Needles (Whipple 1856). Consequently, the specimen was probably collected in Arizona along the Bill Williams River, where the expedition traveled between 1 and 20 February.

Vegetation History

Early History

The warm temperatures of the Paleocene (65 million years ago [mya]) allowed temperate evergreen and tropical rainforests to cover much of North America (Van Devender 2002a,b). During the Eocene (54–35 mya), deciduous forests developed as a result of warmer temperatures and increased seasonality of precipitation (Van Devender 2002b). Many adaptations of present-day desert plants evolved during this time (Van Devender 2002a,b). Grasses diversified in the Oligocene (36.6–23.7 mya; Van Devender 2000).

The early Miocene (30–15 mya) was a time of geologic uplifts and volcanic activity in North America (Van Devender 2002b), although this activity may have occurred earlier in the Oligocene (Van Devender 2002a). The uplifts of the Sierra Madre, Rocky Mountains, Transverse, and Peninsular ranges created rain shadows in the Sonoran Desert region (Axelrod 1995). The several detachment faults in and around the Whipple Mountains were created at this time (Norris 1995; Scarborough 2000). Common desert plants may have speciated in the early to middle Miocene, in thornscrub plant communities further south (Van Devender 2000, 2002a,b). A middle Miocene (15–8 mya) drying trend created much of the Sonoran Desert, and desert vegetation existed by the late Miocene (8–5 mya; Axelrod 1995; Van Devender 2000, 2002a,b).

The marine deposits of the Imperial and Bouse Formations were laid down in the Pliocene (5–1.8 mya) as a result of ocean expansion. At this time the climate was warm and received summer rainfall (Van Devender 2000, 2001, 2002). Lake deposits in the Vidal Valley date to around this time (Bishop 1964).

The region cooled again in the Pleistocene (1.8 mya–10,500 years before present [ybp]; Van Devender 2000, 2002b). Glaciers covered much of the continent, pinyon-juniper forests covered much of the Sonoran desert, and desert or tropical plants, like Cercidium spp. or Carnegiea gigantea, were likely restricted to refugia farther south during glaciation (Wells and Hunziker 1976; Van Devender 1977, 2002a).

Midden Data

Middens are hardened deposits of organic materials collected by packrats (Neotoma spp.). The dried plants contained in middens allow a glimpse of the vegetation in the area when the midden was occupied (Wells and Berger 1967; McAuliffe and Van Devender 1998). The age of the midden is usually determined by radiocarbon dating of organic matter, which can provide records of plants as far back as 51,000 ybp (Van Devender 1990, 2002a; Thomas Van Devender pers. comm.). Four sites in the Whipple Mountains have yielded both Pleistocene and Holocene middens (see Fig. 2; Van Devender 1990; Thomas Van Devender pers. comm.).

Late Pleistocene.—Woodland composed of Juniperus californica, Pinus monophylla, Yucca brevifolia, and
Table 2. Occurrences of fossil plants from 13,810 years before present (ybp) to present.

<table>
<thead>
<tr>
<th></th>
<th>Early Holocene</th>
<th>Middle Holocene</th>
<th>Late Holocene</th>
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<tbody>
<tr>
<td></td>
<td>13,810–10,500 ybp</td>
<td>10,500–9000 ybp</td>
<td>9000–4500 ybp</td>
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<tr>
<td><em>Pinus monophylla</em></td>
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<tr>
<td><em>Yucca brevifolia</em></td>
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<tr>
<td><em>Yucca whipplei</em></td>
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<tr>
<td><em>Juniperus californica</em></td>
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<tr>
<td><em>Artemisia tridentata</em></td>
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<td><em>Artemisia confertifolia</em></td>
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<tr>
<td><em>Cercocarpus intricatus</em></td>
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<td><em>Coleogyne ramosissima</em></td>
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<tr>
<td><em>Nolina bigelovii</em></td>
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<tr>
<td><em>Ephedra nevadensis</em></td>
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<td><em>Crossosoma bigelovii</em></td>
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<td><em>Salvia mohavensis</em></td>
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<tr>
<td><em>Vulpia octoflora</em></td>
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<tr>
<td><em>Bouteloua aristidoides</em></td>
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<tr>
<td><em>Larrea tridentata</em></td>
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<td><em>Achnatherum speciosum</em></td>
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<td><em>Poa bigelovii</em></td>
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<tr>
<td><em>Bromus arizonicus</em></td>
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<tr>
<td><em>Pleuraphis rigida</em></td>
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<td><em>Dasyochloa pulchella</em></td>
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<td><em>Encelia farinosa</em></td>
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<tr>
<td><em>Peucephyllum schottii</em></td>
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<tr>
<td><em>Acacia greggii</em></td>
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<tr>
<td><em>Ambrosia dumosa</em></td>
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<tr>
<td><em>Parkinsonia floridum</em></td>
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<tr>
<td><em>Hypitis emoryi</em></td>
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<tr>
<td><em>Aristida purpurea var. nealleyi</em></td>
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<tr>
<td><em>Aristida ternipes var. hamulosa</em></td>
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<tr>
<td><em>Bouteloua barbata</em></td>
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(from Van Devender 1990; Van Devender et al. 1990).

*Y. whipplei* existed in the Whipple Mountains in late Pleistocene, 13,810–10,500 ybp, with *P. monophylla* occurring as low as 510 m (1670 ft; Table 2; Wells and Berger 1967; Van Devender and Spaulding 1979; Cole 1986; Van Devender 1990, 2002a; Anderson and Van Devender 1991; Lanner and Van Devender 1998). *Juniperus californica* and *Y. brevifolia* were found as low as 260 m (850 ft; Wells and Hunziker 1976). *Quercus turbinella* or *Q. palmeri* probably were associated with these woodland plants at higher elevations (Wells and Hunziker 1976). Additionally, *Artemisia tridentata*, *A. confertifolia*, *Cercocarpus intricatus*, and *Coleogyne ramosissima* were scattered in the area (Van Devender and Spaulding 1979; Van Devender 1990; Van Devender et al. 1990). *Acacia greggii*, *Aloysia wrightii*, *Bouteloua aristidoides*, *Crossosoma bigelovii*, *Encelia farinosa*, *Ephedra aspera*, *Nolina bigelovii*, *Salvia mohavensis*, and *Vulpia octoflora* were also present at this time and still occur in the area (see Appendix 2; Van Devender 1990; Van Devender et al. 1990; Anderson and Van Devender 1991; USDA 2004; Thomas Van Devender pers. comm.). Many of these plants are now more common in the Mojave Desert and Great Basin, and today’s Sonoran plants were scarce in middens (see Van Devender 1977; Van Devender and Spaulding 1979; Cole 1986). In the nearby Kofa Mountains in Arizona, *Castella emoryi* grew at 550 m (1800 ft) with juniper and Joshua tree, while today it occurs rarely in desert lowlands in the area (e.g., near Chemehuevi Wash; Van Devender and Spaulding 1979). *Larrea tridentata* arrived in the late Pleistocene (ca. 11,000 ybp), and creosote bush communities occurred below 300 m (984 ft) in the Lower Colorado valley (Wells and Hunziker 1976; Van Devender 1977, 2002b; Rowlands 1995a). These individuals were diploids (Hunter et al. 2001). The winter climate was similar to the present, but summers were cooler, and most precipitation fell in winter (Van Devender 1977, 1990, 2002a; Van Devender and Spaulding 1979).

**Holocene.**—The early Holocene, from about 10,500 to 9000 ybp, probably received little or no summer rainfall (Van Devender and Spaulding 1979; Van Devender 1990). Van Devender and Spaulding (1979) also report that *Pinus monophylla* and *Yucca brevifolia* most likely retreated north out of the Whipple Mountains by 10,000 ybp. Prominent species of the modern flora were present, including *Acacia greggii*, *Achnatherum speciosum* [= *Sipha speciosa*], *Ambrosia dumosa*, *Bromus arizonicus*, *Dasyochloa pulchella* [= *Erioneuron pulchellum*], *Encelia farinosa*, *Larrea tridentata*, *Opuntia basilaris*, *Peucephyllum schottii*, *Pleuraphis rigida* [= *Hilaria rigida*], and *Poa bigelovii* (Table 2; Van Devender 1977, 1990, 2002b; Van Devender et al. 1990; Thomas Van Devender pers. comm.). *Carnegiea gigantea* expanded to the northern edge of its present range during this time and also may have arrived in the Whipple Mountains, but there are no records of it from middens in the area. At this time it was generally more common than it is today throughout the rest of its present range (Van Devender 2002a). Creosote-bursage (*Larrea tridentata*, *Ambrosia dumosa*) communities were well developed in lower areas along the Colorado River (Van Devender and Spaulding 1979).

The middle Holocene, from 9000 to 4000 ybp, had essentially hot summers, some summer rainfall (perhaps greater than today), and occasional winter freezes (Van Devender 1990; Van Devender et al. 1990). *Yucca whipplei* and *Juniperus californica* ceased to exist in the area by 8000 ybp (Van Devender and Spaulding 1979; Van Devender 1990). Documented new arrivals during this period include *Aristida purpurea var. nealleyi* [= *A. cf. glauca*], *A. ternipes var. hamulosa* [= *A. hamulosa*], *Bouteloua barbata*, *Parkinsonia floridum*, *Fouquieria splendens*, and *Hypitis emoryi*, as well as...
other desert scrub plants (Van Devender 1977, 1990; Van Devender and Spaulding 1979; Van Devender et al. 1990). Hexaploid *Larrea tridentata* individuals were found in pacrat middens in the Whipple Mountains as recent as about 3900 ybp, and at present the range probably contains a mix of hexaploid and tetraploid plants (Hunter et al. 2001).

Essentially modern desert plant communities and the modern climate regime of hot summers and little rainfall were established about 4500 ybp (Van Devender 1990, 2001, 2002a, 2002b; Anderson and Van Devender 1991). *Bouteloua barbata* and *Dasyochloa pulchella* [= *Eri-omeuron pulchellum*] were the only grasses found in midden samples of this age (Van Devender et al. 1990). *Parkinsonia microphylla* and *Oleyna tesota* also may have arrived during this time (Van Devender 2001).

**Recent History**

Much of the riparian area bordering the river supported cottonwood-willow habitat during the time of early exploration (Sitgreaves 1854; Bigelow 1856; Ives 1861; Alexander 1939). This habitat is now scarce due to development. Ives (1861) writes that there was little vegetation in the Chemehuevi Valley other than isolated patches of mesquite near the river. Although Sitgreaves’ report (1854: 18) states that the county was “barren and devoid of interest,” it does mention some plants that were found along the Colorado River: “Some large cotton-wood trees [*Populus angustifolia, P. monilifera*] grow directly upon the river banks, but the growth of the rest of the valley is small, consisting chiefly of mezquit [“Algarobia glandulosa” = *Prosopis glandulosa*], tornilla [“Prosopis odorata” = *P. pubscens*], willow [*Salix spp.*], and a singular tree with smooth, pale green bark, and leaves so diminuitive as to require a close proximity to discern them [perhaps *Parkinsonia microphylla*]. The shrubs are the arrowwood [“Tessaria borealis” = *Pluchea sericea*], wild sage [probably *Hypis* or *Salvia*], hediondilla, or creosote plant, and grease weed [*Atriplex canescens*]...” (21–22, 39–40). Also mentioned are “Cereus giganteus” (= *Carnegiia gigantea*), *Phoradendron californicum*, “*Machaeranthera canescens*” (= *Machaeranthera asteroides*), “Arundo phragmites” (= *Phragmites communis*), a tall clumped grass (perhaps *Pleuraphis rigida*), and a smaller kind of grass with crusts of salt on its leaves (perhaps *Distichlis*; Sitgreaves 1854: 22, 160, 161; see also Bigelow 1856; Whipple 1856). Additionally, Bigelow (1856: 14) mentions an “aromatic shrub” belonging to “Ambrosiae, of Compositae,” which the mules ate (perhaps *Ambrosia dumosa*).

**PRESENT VEGETATION**

Nine plant communities (as defined by Holland and Keil 1995; Rowlands 1995b) were recorded in the Whipple Mountains. Creosote bush scrub is the dominant vegetation type on lower mountain slopes below 915 m (3000 ft) elevation and over bajadas and valleys of the Sonoran Desert (see Fig. 4; Shreve 1964; Holland and Keil 1995; Rowlands 1995b). It is the primary vegetation type on the plains of mixed Quaternary alluvium around the mountains. Dominant species include *Larrea tridentata*, *Ambrosia dumosa*, and *Encelia farinosa*; also common are *Ferocactus cylindraceus var. cylindraceus*, *Cylindropuntia bigelovii*, *C. echinocarpa*, *O. basilaris var. basilaris*, and *Pleuraphis rigida* (see also Holland and Keil 1995). In the Whipple Mountains, *L. tridentata* has been collected between 91 and 1055 m (300 and 3460 ft). *Pleuraphis rigida*, often considered restricted to lower plains, dunes, and bajadas (Shreve 1964), was collected just over 1097 m (3600 ft) on a ridge. Common plants not found on lower bajadas but associated with *L. tridentata* at higher elevations are *Agave deserti*, *Echinocereus engelmannii*, *Ephedra aspera*, *Ephedra fasiculata*, *Lycium fremontii*, and *Nolina bigelovii*.

The bluffs of Tertiary volcanic rock on the eastern side of the mountains are sparsely vegetated, possibly a consequence of a lack of penetration by water or roots (Shreve 1964). In most places, sloping piles of boulders obscure the bases of these bluffs. A few common species that are encountered among or on these rocks include *Euclid.waitFor urceus*, *Machaeranthera pinna-tifida* subsp. gooddingii, *Peucephyllum schottii*, and *Pleurocoronis pluriseta* (see also Rowlands 1995b). These plants may also be found on red Tertiary sedimentary deposits in the vicinity of Bowman’s Wash.

Only a few small areas along the Colorado River support sand dune plants. Prominent species here are *Abronia villosa*, *Dicoreca canescens*, *Ephedra trifurca*, *Hesperocallis undulata*, *Onothera deltoides* subsp. *deltooides*, *Palofoxia arida* var. arida, *Pleuraphis rigi-da*, and *Tiquilia palmeri*. Occasionally some of these plants may be found in sandy washes. This community is probably the most threatened since most dune areas in the mountains are designated off-highway vehicle (OHV) areas.

One unique community in the Whipple Mountains is the foothill paloverde-saguaro woodland (Rowlands 1995b). This vegetation type is restricted to the rocky slopes on the eastern side of the mountains, near the river, and plant density is low (104 *Carnegiea gigantea* individuals in 6 square miles; Brum 1973). Besides *C. gigantea* and *Parkinsonia microphylla*, the shrubs present are typical of creosote bush scrub.

Floodplains and small basins along the Colorado River are home to alkali sink plant communities. These
plants tolerate up to 2.5% salts in the soil (Rowlands 1995b). *Allenrolfea occidentalis, Atriplex canescens, Acacia lentiformis* subsp. *lentiformis, A. polycarpa, Distichlis spicata,* and *Suaeda moquinii* may be found in these areas.

Many drainages from the mountains support desert wash communities. Characteristic trees in larger washes through the bajadas are *Olneya tesota* and *Psorothamnus spinosus.* Common in all washes are *Acacia greggii,* *Ambrosia salsola var. salsola, Bebbia juncea, Brandegea bigelovii, Parkinsonia florida,* *Hyptis emoryi, Lycium andersonii,* and *Phoradendron californicum.* *Sporobolus airoides* is found in washes usually above 305 m (1000 ft), where it is frequently associated with exposed granitic bedrock. In the springtime, washes support a colorful diversity of annuals. Non-native *Tamarix chinensis* is occasionally encountered in mountain washes.

Common shrubs in Chemehuevi Wash are *Acacia greggii,* *Ambrosia salsola var. salsola, Chilopsis linearis,* and *Ericameria paniculata,* which approximate cheesebush scrub (Rowlands 1995b). Although *Acacia greggii* and *Ambrosia salsola var. salsola* are found in smaller washes throughout the mountains, they are usually not as prolific as observed in Chemehuevi wash, where *Chilopsis linearis* and *Ericameria paniculata* are restricted. The trees, *Parkinsonia floridula* and *Psorothamnus spinosus,* are typical of large desert washes.

A few canyons contain year-round running water, and support desert riparian communities. *Baccharis sergilloides, Pluchea sericea, Populus fremontii,* *Prosopis glandulosa var. torreyana,* and *Washingtonia filifera* are found along with non-natives *Nerium oleander,* *Phoenix dactylifera,* and *Tamarix chinensis* (see Fig. 7). *Washingtonia filifera* may have naturalized from cultivated plants in human developments along the river, since it is found only in canyons close to the river (except a single individual in Whipple Wash). Aquatic plants, such as *Myriophyllum sibiricum, Najas marina, Potamogeton nodosus,* and *P. pectinatus* may be encountered.

Much of the Colorado River bottom habitat has been lost due to development, but a few areas still support this plant community. Typical plants include *Pluchea sericea, Populus fremontii, Prosopis glandulosa var. torreyana, P. pubescens, Salix gooddingii, S. exigua,* and *Typha domingensis.* Portions of this habitat have been invaded by *Arundo donax* and *Tamarix chinensis.*

**WHY ARE SOME SONORAN DESERT PLANTS NOT FOUND WEST OF THE COLORADO RIVER?**

Shreve (1964: 50) observed that “there are also some notable floristic differences between the eastern and western edges of the area [the Sonoran Desert].” According to Van Devender (1977), factors that have historically affected plant distribution in the southwestern United States are temperature regimes (winter lows and summer highs) and rainfall patterns (winter vs. summer precipitation). Both temperature and precipitation are influenced by topography and elevation (Beatley 1975), with moisture probably more influential in determining the distributions of plants (Beatley 1974, 1975; Van Devender and Spaulding 1979).

Summer rainfall, which occurs between June and October, may have a great influence on biotic distributions. Some annuals germinate only in response to summer rainfall. Summer annuals were not found in packrat middens in the Whipple Mountains until summer precipitation began to occur (Van Devender and Spaulding 1979). Summer moisture or orographic effects may influence the lower elevational limit of woodland in the Mojave Desert (Wells and Berger 1967). A factor influencing the establishment of saguaro seedlings is July–August precipitation (Brum 1973). Summer rainfall may be a limiting factor for the western limits of some Sonoran Desert plants (Van Devender and Spaulding 1979).

Today in the Sonoran Desert, summer rainfall increases toward the southeast and winter rainfall increases toward the northwest (Fig. 13; Shreve 1964; Van Devender and Spaulding 1979). During the summer monsoon season (Jun–Oct) in the southwestern United States, a distinct anticyclone of high pressure is present over northwestern Mexico, along with a trough that allows tropical moisture to move up the Gulf of California and into Arizona and New Mexico (Higgins et al. 2002). The clockwise direction of the anticyclonic flow may induce summer storms to move up the Colorado Valley or curve eastward after reaching the head of the Gulf of California rather than turning westward. This reduces the chances of the California Sonoran Desert receiving as much rainfall as the Arizona portion of the Sonoran Desert. The intensity of the monsoon rains varies annually, even within a single summer, and is influenced by factors such as winter moisture in the southwest and northwest states, the El Niño/Southern Oscillation, and snow pack in the western United States (Higgins et al. 2002).

The Whipple Mountains today receive about 36% (43.0 mm; 1.69 in) of their annual rainfall of 119.5 mm (4.70 in) in summer monsoons from June through October (Fig. 14; see also Van Devender 1990; Van Devender et al. 1990; Rowlands 1995a). To the east, more precipitation falls in the summer than in the winter (Fig. 14; Seligman, Tucson). In Buckeye, near Phoenix, about 44% of total annual precipitation falls in the summer. Along the Colorado Valley, summer rainfall accounts for 36 to 48% of the annual total.
Summer rainfall, however, is extremely variable, even in areas that receive a substantial portion of their annual precipitation from summer monsoons (see Fig. 8 in De Groot 2004). Since the amount of summer rainfall in all areas of the Sonoran Desert varies widely between years, the quantity is probably less important than the fact that precipitation occurs during the summer months (see also Beatley 1975, 1976).

Since Parker generally receives some summer moisture, less than areas farther east (e.g., Buckeye), but more than areas farther west (e.g., Indio), plants that depend on summer moisture (e.g., *Carnegiea gigantea*) may be able to survive. In most cases, the western margins of their ranges fall in the Whipple Mountains (e.g., List 2 taxa in Table 6). To the east, greater summer rainfall allows these plants to flourish, while to the west lack of summer rainfall prohibits establishment. The occurrences of California Sonoran, Mojave, and also these Arizona Sonoran desert plants within the mountains create a unique flora, as the area is more or less the only place where these elements have the potential to co-occur.

**SURVEY METHODS**

Collecting permits were obtained from all four land management agencies [BLM 6850(P) CA-930; Chemehuevi Indian Tribe 21 Jul 2003; MWD 28 Aug 2003; CRIT 2004002; Appendix 3 in De Groot 2004]. An additional permit was obtained from the San Bernardino County office of the US Department of Agriculture (USDA) to cover rare desert plants described in Section 80072 of the California Food and Agricultural Code, not covered under the BLM permit (permit 36-153003-1; John Willoughby pers. comm.; De Groot 2004).

Twenty-seven trips were made to the study area, resulting in 69 days of field-collecting at 425 localities (Fig. 16). In all, 3564 specimens were collected and identified, 163 (4.57%) of which were cacti, a traditionally under-collected group. A field press was used in making most collections (Herbarium Supply Company, Item 180). Each trip attempted to cover different regions of the Whipple Mountains, in order to sample as many locations and habitat types as possible. Several all-day hikes and two backpack trips were made into the Wilderness area. At many localities, samples of all plants present were collected.

Five regional herbaria were searched for specimens from the Whipple Mountains. These were the California Academy of Sciences/Dudley Herbarium (CAS/
Fig. 16. Localities of all plant collections used in this study (white Xs: previous collections; white circles: De Groot). The study area boundary is marked with a solid white line. Reproduced with permission (©2004 DeLorme [www.delorme.com] TopoUSA®, vers. 5.0).

Early collections, such as those made on army expeditions, were not searched due to time and funding constraints, and since cursory glances at the vague locality information given in the reports did not yield any specimens that may have come from the area. All specimens (867) were received on loan for verification of determinations. Of these, 124 were duplicates, leaving 743 unique specimens. J. Mark Porter contributed 213 collections from 2001. In total, 4525 specimens were examined.

Numerical Summary

Sixty-eight families of vascular plants, as recognized by Thorne with Reveal (2005) and Hoogland and Reveal (2005; see also Baldwin et al. 2002) were represented. There were 376 species and 9 infraspecific taxa, for a total of 385.

Five hybrids were discovered. *Opuntia wigginsii* is placed on CNPS List 3 (Tibor 2001), but this may be either a hybrid of *Cylindropuntia ramosissima* × *C. echinocarpa*, or merely a dwarf form of *C. echinocarpa* (Tibor 2001; Baldwin et al. 2002; Pinkava 2004). It is occasionally encountered in the bajadas around the mountains. *Parkinsonia microphylla* × *P. florida
had been found along Parker Dam Road on the south-east side of the mountains (Jones et al. 1998). In the present study it was collected primarily throughout the eastern side of the range. One collection was made of peppermint (Mentha × piperita) in a disturbed area along the Colorado River. This plant almost certainly escaped from cultivation. Camissonia brevipes × C. claviformis was collected from roadways and washes in both the eastern and western portions of the range. Lycium andersonii × L. fremontii was collected once in a wash with more typical forms of both L. andersonii and L. fremontii also present.

Of 188 annuals, 162 (86.2%) germinate in the winter, generally flowering in the spring or early summer. Fourteen (7.4%) germinate in response to summer precipitation. An additional twelve (6.4%) germinate in response to any rainfall, and have been collected both in the spring and fall. Many perennials also flower following plentiful rainfall, either in the winter or summer, frequently twice in the same year.

Non-Native Taxa

The Whipple Mountains contain 44 non-native plants (11.4% of the total), many of which occur in disturbed areas along the Colorado River (Table 3). Fifteen of these (34.1%) are grasses (Poaceae). Poaceae contain 28 native and 15 non-native (34.9%) grasses. In contrast, four of 66 plants (6.1%) in Asteraceae are non-native. Several introduced species are found throughout the mountains, namely, Brassica tournefortii, Schismus barbatus, Tamarix chinensis, and Vulpia bromoides.

The percentage of non-natives appears high compared to other floras. Glass Mountain, in Mono County, California, has only 14 non-native taxa (2.9%, Honer 2001). McLaughlin and Bowers (1990) recorded 34 introductions (5.1%) in the Santa Rita Mountains of southern Arizona. The East Mojave ranges have 66 or 8.1% non-native plants (Thorne et al. 1981), and Clark Mountain is home to just 29 (7.0%; Prigge 1975). Most of these sites, however, are relatively remote with little human activity. In contrast, the Whipple Mountains Study Site includes the housing tract of Big River, the towns of Earp, Vidal, and Parker Dam, and numerous mobile home parks and recreational developments along the Colorado River. The cultivated plants in these communities were not sampled, but a number of plants naturalized into nearby areas and were collected there. Some examples are Cyperus involucratus, Mentha × piperita, Nerium oleander, and Schinus terebinthifolius.

Diversity

Measured the traditional way, 385 different kinds of plants found on about 129,500 hectares (500 square miles) equals a diversity of 0.00297 species, subspecies, or varieties per hectare (0.770 species, subspecies, or varieties per square mile). This is comparable to the diversity documented at the Nevada Test Site and in the eastern Mojave ranges (Table 4; Fig. 17; Beatley 1976; Thorne et al. 1981). Clark Mountain was more diverse (Prigge 1975), as was Glass Mountain of the Great Basin desert (Honer 2001) and the Tucson Mountains of the Arizona Upland division of the Sonoran Desert (Rondeau et al. 1996). The Santa Rita Mountains, primarily in the Chihuahuan floristic element, have even higher diversity (McLaughlin and Bowers 1990).
Table 4. Floristic diversity in the southwestern deserts.

<table>
<thead>
<tr>
<th>Flora</th>
<th>Area: hectares (square miles)</th>
<th>Taxa</th>
<th>Diversity: taxa/hectare (taxa/square mile)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nevada Test Site</td>
<td>349,648 (1350)</td>
<td>729</td>
<td>0.0021 (0.540)</td>
<td>Beatley 1976</td>
</tr>
<tr>
<td>East Mojave Ranges</td>
<td>329,000 (1270)</td>
<td>819</td>
<td>0.0025 (0.645)</td>
<td>Thorne et al. 1981</td>
</tr>
<tr>
<td>Whipple Mountains</td>
<td>129,500 (500)</td>
<td>385</td>
<td>0.0030 (0.770)</td>
<td>This study</td>
</tr>
<tr>
<td>Glass Mountain</td>
<td>72,520 (280)</td>
<td>489</td>
<td>0.0067 (1.746)</td>
<td>Honer 2001</td>
</tr>
<tr>
<td>Tucson Mountains</td>
<td>40,000 (154)</td>
<td>633</td>
<td>0.0158 (4.110)</td>
<td>Roundeau et al. 1996</td>
</tr>
<tr>
<td>Clark Mountain</td>
<td>36,260 (140)</td>
<td>407</td>
<td>0.0112 (2.907)</td>
<td>Prigge 1975</td>
</tr>
<tr>
<td>Santa Rita Mountains</td>
<td>26,000 (100)</td>
<td>662</td>
<td>0.0255 (6.620)</td>
<td>McLaughlin and Bowers 1990</td>
</tr>
</tbody>
</table>

However, this raw measure of lower taxa per unit of area can be deceiving. Larger areas, like the East Mojave ranges or the Nevada Test Site, may have lower diversities simply because they cover larger areas. The addition of 2,071,991 hectares around the Nevada Test Site added only 364 plants, decreasing the diversity from 0.0021 species, subspecies, or varieties per hectare (0.540 species, subspecies, or varieties per square mile) to 0.0005 (0.117; Beatley 1976). Also, taxonomists will note that these ranks themselves are not equivalent and therefore not appropriate to compare as if they were.

The Whipple Mountains flora shares more species with Joshua Tree National Park than with any other flora used in comparison (Fig. 17; Table 5; Steve McLaughlin pers. comm.). As expected, its affinities appear to be primarily to the Californian portion of the Sonoran Desert, but compares fairly well with a number of Mojave and Arizona Sonoran floras. It shares fewer species with floras in the Colorado Plateau, Chihuahuan, and Great Basin deserts. Arizona Upland floras have fewer Whipple Mountains species than floras from the Sonoran Desert in Arizona. Roughly, based on ranges given in Baldwin et al. (2002) and Hickman (1993), the Whipple Mountains flora has 64.1% widespread taxa, 10.4% Sonoran (common in California), 10.4% Mojave, 2.9% mostly found east of the Colorado River, 11.4% introduced, and 0.8% with no range given (unlisted hybrids).

Sensitive Taxa and Interesting Finds

The Whipple Mountains contain 17 plants listed by the California Native Plant Society (Table 6; Tibor 2001). These plants are from thirteen different families, with more than one plant in Cactaceae, Euphorbiaceae, and Fabaceae. Most are more common in Ar-
Table 5. Number and percentage of Whipple Mountains taxa occurring in other floras in the southwestern United States.

<table>
<thead>
<tr>
<th>Floristic region</th>
<th>Flora</th>
<th>Number of taxa</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mojave/California</td>
<td>Joshua Tree National Park (Riverside Co., CA)</td>
<td>248</td>
<td>75.6</td>
</tr>
<tr>
<td>Sonoran</td>
<td>SE San Diego Co. (San Diego Co., California)</td>
<td>217</td>
<td>66.2</td>
</tr>
<tr>
<td>California Sonoran</td>
<td>Castle Dome Mountains (Yuma Co., Arizona)</td>
<td>191</td>
<td>58.2</td>
</tr>
<tr>
<td>Arizona Sonoran</td>
<td>Granite Mountains (San Bernardino Co., California)</td>
<td>176</td>
<td>53.7</td>
</tr>
<tr>
<td>Mojave</td>
<td>Nevada Test Site (Nevada Co.)</td>
<td>161</td>
<td>49.4</td>
</tr>
<tr>
<td>Arizona Upland</td>
<td>Tucson Mountains (Pima Co., Arizona)</td>
<td>161</td>
<td>49.1</td>
</tr>
<tr>
<td>E Mojave</td>
<td>Beaver Dam Mountains (SW Utah)</td>
<td>149</td>
<td>45.4</td>
</tr>
<tr>
<td>Arizona Upland</td>
<td>Greater Sedona Area (Yavapai Co., Arizona)</td>
<td>105</td>
<td>32.0</td>
</tr>
<tr>
<td>Arizona Upland</td>
<td>Hualapai Mountain Park (Mohave Co., Arizona)</td>
<td>52</td>
<td>15.9</td>
</tr>
<tr>
<td>Chihuahuan</td>
<td>Huachuca Mountains (Cochise Co., Arizona)</td>
<td>51</td>
<td>15.5</td>
</tr>
<tr>
<td>Colorado Plateau</td>
<td>Canyon de Chelly (Apache Co., Arizona)</td>
<td>38</td>
<td>11.6</td>
</tr>
<tr>
<td>Great Basin</td>
<td>Wheeler Peak (E Central Nevada)</td>
<td>15</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Source: Steve McLaughlin pers. comm.

Table 6. Taxa occurring in the Whipple Mountains area that are either rare and listed by the California Native Plant Society (CNPS), or previously unreported in California’s flora (*).

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Family</th>
<th>CNPS List</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aloysia wrightii</td>
<td>Verbenaceae</td>
<td>4</td>
</tr>
<tr>
<td>Androstachyum breviflorum</td>
<td>Alliaceae</td>
<td>2</td>
</tr>
<tr>
<td>Berberis harrisoniana</td>
<td>Berberidaceae</td>
<td>*</td>
</tr>
<tr>
<td>Bouteloua tritida</td>
<td>Poaceae</td>
<td>2</td>
</tr>
<tr>
<td>Carnegiea gigantea</td>
<td>Cactaceae</td>
<td>2</td>
</tr>
<tr>
<td>Castela emoryi</td>
<td>Simaroubaceae</td>
<td>2</td>
</tr>
<tr>
<td>Cercidium [Parkinsonia] microphyllum</td>
<td>Fabaceae</td>
<td>4</td>
</tr>
<tr>
<td>Cryptantha holoptera</td>
<td>Boraginaceae</td>
<td>4</td>
</tr>
<tr>
<td>Delphinium scaposum</td>
<td>Ranunculaceae</td>
<td>*</td>
</tr>
<tr>
<td>Ditaxis clariana</td>
<td>Euphorbiaceae</td>
<td>2</td>
</tr>
<tr>
<td>Erigeron oxypollus</td>
<td>Asteraceae</td>
<td>*</td>
</tr>
<tr>
<td>Matelea parviflora</td>
<td>Apocynaceae</td>
<td>2</td>
</tr>
<tr>
<td>Opatnia [Cylindropuntia] wigginsii</td>
<td>Cactaceae</td>
<td>3</td>
</tr>
<tr>
<td>Pholistoma auritum var. arizonicum</td>
<td>Hydropapaceae</td>
<td>2</td>
</tr>
<tr>
<td>Proboscidea altheifolia</td>
<td>Martyniacae</td>
<td>4</td>
</tr>
<tr>
<td>Psorothamus fremontii var. attenuatus</td>
<td>Fabaceae</td>
<td>2</td>
</tr>
<tr>
<td>Quercus turbinella</td>
<td>Fagaceae</td>
<td>4</td>
</tr>
<tr>
<td>Sena covesii</td>
<td>Fabaceae</td>
<td>2</td>
</tr>
<tr>
<td>Tetracobus hallii</td>
<td>Euphorbiaceae</td>
<td>4</td>
</tr>
<tr>
<td>Teucrium glandulosum</td>
<td>Lamiaceae</td>
<td>2</td>
</tr>
</tbody>
</table>

* CNPS Listings from CNPS Inventory, ed. 6. (Tibor 2001). List 2: rare, threatened, or endangered in California, but more common elsewhere. List 3: more information needed. List 4: limited distribution, a watch list.

* Listed as O. wigginsii, which may be a hybrid between Cylindropuntia ramosissima and C. echinocarpa, or a dwarf form of C. echinocarpa (Baldwin et al. 2002; Pinkava 2004).

Arizona, and the Whipple Mountains lie on the western edges of their ranges. Several plants are known only from a single occurrence (e.g., Androstachyum breviflorum, Matelea parviflora, Castela emoryi). Some occur primarily in the eastern portion of the mountains (Carnegiea gigantea, Parkinsonia microphyllum, Ditaxis clariana, Teucrium glandulosum). Others are restricted to higher elevations (Aloysia wrightii, Quercus turbinella, Sena covesii). A few are scattered throughout the mountains (Pholistoma auritum var. arizonicum, Psorothamus fremontii var. attenuatus).

Three species previously unrecorded in California also occur in the mountains. Berberis harrisoniana Kearney and Peebles was collected from one locality in the northeast part of the range, in a north-facing rocky chute. This plant was known from only five extant populations in Arizona and was thought to be endemic there. It was discovered in the Whipple Mountains by the BLM in 2001 (Anderson and De Groot 2004). It is listed as a Sensitive Species by the BLM and was considered for federal listing, but rejected because it did not appear threatened (Malusa 1995).

Delphinium scaposum Greene had not been reported from California, although it is widespread in Arizona, Colorado, Nevada, New Mexico, Utah, and occasional in Sonora, Mexico. It had been collected along the Bill Williams River and in the Mojave Mountains just a few miles to the east in Arizona. It is sparsely distributed throughout the mountains, and found in rocky washes or on rock outcrops (De Groot 2005).

Scattered on rocky hillsides and in washes generally above 915 m (3000 ft), Erigeron oxypollus Greene was also a new state record. It had been collected in Maricopa, Mohave, Pinal, and Yuma counties, Arizona, and in Sonora, Mexico (De Groot 2005).

These three species show that botanical exploration can still yield important discoveries. The Whipple Mountains have a unique flora, with plants from the Mojave and both sides of the Sonoran Desert. The 385 different taxa documented in this study show that A.W. Whipple’s “pile of black mountains” (Whipple 1856: 109) is not just a bare pile of rock.

ACKNOWLEDGMENTS

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LITERATURE CITED


MARCOU, J. 1856. Part 4, Report of the geology of the route, no. 2 Resumed and field notes. Route near the thirty-fifth parallel of north latitude, from the Mississippi River to the Pacific Ocean, pp. 121–164. In Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Missis- sippi River to the Pacific Ocean [Pacific Railroad Reports], vol. 3. A. O. P. Nicholson, Printer, Washington, D.C., USA.


PROEG, B. A. 1975. Flora of the Clark Mountain range, San Bernar- dino County, California. M.S. Thesis, California State University at Los Angeles, USA.


APPENDIX 2.

ANOTATED CATALOG OF THE FLORA

The following is a list of the plants documented in the Whipple Mountains study area, from fieldwork and herbarium searches, and is current as of April 2006. The angiosperm families are based on Hitchcock (1932), Torr. (see Huang et al. 2005). Shrub, locally common'' or ''locally frequent.'' Collections are from BLM land unless noted otherwise (ARIZ, University of Arizona at Tucson; CAS, California Academy of Sciences; DS, Dudley Herbarium; JEPS, Jepson Herbarium; POM, Pomona College; UC, University of California at Berkeley; UCR, University of California at Riverside). Non-native taxa are indicated with an asterisk (*). Frequency of taxa is indicated by "common," "frequent," "occasional," "in-frequent," or "rare," and those that are restricted to specific habitats or have patchy distributions within the site may be designated "locally common" or "locally frequent." Collections are from BLM land unless noted MWD (Metropolitan Water District), CRIR (Chemehuevi Indian Reservation), or CIR (Chemehuevi Indian Reservation). While many specimens were examined for this study, only one representative voucher specimen is cited [see De Groot (2004) for a complete listing of specimens].
mon in sandy soil near the river. Just W of Colorado River, Copper Basin Dunes OHV area. 20 Apr 2001 J.M. Porter 12500.

**ANTHOPYTAC: MAGNOLIOPSIS** Bronn.

**AGAVACEAE** Dumort.


**AIZOACEAE** Martynov


**ALLIACEAE** Batsch ex Borkh.

**ANDROSTEPIUM BREVIPLORUM** S.Watson. Rare annual, growing on sand dunes. CNPS List 2. Dune OHV area near Echo Lodge, along Parker Dam Road. 1 Mar 2003 S.J. De Groot & J.M. Porter 1165.

**AMARANTHACEAE** Juss.


**ANACARDIACEAE** R.Bl.

*RHUS LANCEA* L. Large solitary shrub, in brush thickets back from the river near the side of the highway. Along the Colorado River at Earp, N side of highway to Parker. CRIR. 21 Nov 2001 C. McGough s.n.; UCR 118742.


*SCHNIT TEREBINTHIFOLIUS* Raddi. Large solitary shrub ca. 2 m high, among *Arundo donax* and *Pluchea sericea*, on river bank, in silty alkaline soil. Rock House boat ramp, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3144.

**APICACEAE** Lindl.


**HYDROCOTYLE VERTICILLATA** Thunb. Perennial, locally common but restricted to a few shallow inlets and backwaters along the river. Bass Point, along Parker Dam Road. 1 Mar 2003 S.J. De Groot & J.M. Porter 1047.

**APOCYNACEAE** Juss.


**ASCLEPIAS EROSA** Torr. Occasional in sandy washes and on road shoulders, generally below 305 m (1000 ft). Chemehuevi Wash at junction with Highway 95 (Hwy 95), N of Vidal Junction. 5 Apr 2003 S.J. De Groot & L. De Groot 2254.


**NERIUM OLEANDER** L. Shrub, locally common in canyons with flowing water and in disturbed areas along the Colorado River, generally below 305 m (1000 ft). Gene Wash, upstream from swimming hole. MWD. 25 Oct 2003 S.J. De Groot & N. Fraga 3373.

**ARECACEAE** Schultz Sch.

*PHOENIX DACTYLFERA* L. Naturalized into riparian areas where it is fairly common; native to northern Africa. Along Parker Dam Road, several miles S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M. Porter 1475.


**ASTERACEAE** Martynov


**AMBROSIA DUMOSA** (A.Gray) Payne. A dominant shrub on hillsides, sand dunes, and in washes. Whipple Wash where it joins the road to Havasu Landing, about 0.5 mi below Willow Spring and 1.25 mi above Lake Havasu. 23 Apr 1983 A.C. Sanders 3781; UCR 31227.


BACCHARIS EMORYI A.Gray Shrub, ca. 2 m high, single collection. Edge of Colorado River just S of Headgate Rock Dam, N of Parker and Earp. CRIR. 10 Apr 2004 S.J. De Groot 4063. This specimen could possibly be B. sergiloides, but with very toothed leaves.


BEBBIA JUNCEA (Benth.) Greene var. ASPERA Greene. Shrub, common in washes. Stem pubescent varying from bristly to glabrous (see also Whalen 1977). 6.5 mi N of Crossroads, Colorado River. 3 May 1939 A.M. Alexander 374; DS 269434.


CONYZA COULTERI A.Gray. Rare, mostly in alkaline disturbed sites, alluvial soil. From Parker Bridge N along Colorado River. CRIR. 2 May 1978 Faulkner 569; UCR 33555.

DECORIA CANESCENS A.Gray. Annual, restricted to sand dunes, but fairly frequent there. Copper Basin dunes OHV area near Echo Lodge, along Parker Dam Road; in flower. 12 Dec 2003 S.J. De Groot & F. Navidara 3466.


ENCELLA FRUTESCENS A.Gray. Shrub, frequent in sandy areas and on roadsides, generally below 305 m (1000 ft). Small wash along road between Vidal and Big River, just E of the Travel at Your Own Risk sign. 9 Oct 2003 S.J. De Groot, J.M. Porter & L. Machen 3269.

ENCELLA VIRGINENSIS A.Nelson. Rare shrub, next to rock in pebbly


EUTHAMIA OCCIDENTALIS Nutt. Infrequent perennial in bog areas near open water. Bass Point, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3185.


HELIAanthus ANNUUS L. Annual, locally common in moist ditches and disturbed areas along the Colorado River. Ditch at intersection of Parker Dam Road and MWD road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3158.

HETEROTHECA SUBAXILLARIS (Lam.) Britt. & Rusby var. PSAMMOPHILA (B.Wagenkn.) Gandhi (Gandhi 1990) = Heterotheca psammophila B.Wagenkn. Mouth of a large wash, in sandy soil near the river. Collected along Colorado River at Big River, SW of Earp. CRIR. 15 Nov 1980 A.C. Sanders 2043; UCR 23019, UC 1494253.

HYMENOXYS ODORATA DC. Annual, on flats near the river, not collected here since 1949. 5.7 mi N of Crossroads, Colorado River. 22 Apr 1940 A.M. Alexander & L. Kellogg 1203; UC 667438, DS 309797.

MACHERANTHERA ASTEROIDEA (Torr.) Greene. Suffrutescent perennial, infrequent on road shoulders and in silty soil near the river. 5.7 mi N of Crossroads, Colorado River. 22 Apr 1940 A.M. Alexander & L. Kellogg 1202; UC 667460, ARIZ 88075.

MACHERANTHERA PANNIFIDA (Hook.) Shimmers subsp. GOODDINGII (A.Nelson) B.L.Turner & R.L.Hartm. Frequent subshrub, often growing in rock cracks, in washes and on rocky slopes. American Eagle Prospect, 14 mi S of Vidal on old road to Needles. 30 Apr


PALAFOXIE ANNA A.W.Turner & M.Moris. Annual or short-lived perennial, occasional in sandy soil and washes generally below 305 m (1000 ft). Just W of Colorado River, near Echo Point, Copper Basin Dunes OHV area. 20 Apr 2001 J.M. Porter 12482.

PECTIS PAPOSA Harvey & A.Gray. Summer annual, occasional or locally abundant on clay flat areas in or near washes, also infrequent on ridges around 915 m (3000 ft). Wash beside Ashicon, Topopah and Santa Fe Railroad tracks, just E of Vidal and Hwy 95. 9 Oct 2003 S.J. De Groot, J.M. Porter & L. Machen 3251.


PORTYRIOTES RAMOSISSIMA (Torr.) A.Gray. Annual or short-lived perennial, uncommon among rocks on open slopes. W of Copper Basin, just W of divide between Copper Basin and Whipple Wash drainages. 11 Apr 2004 S.J. De Groot 4123.


PSAETHYRITES MACRORHIZUS (Torr.) A.Gray. Annual or short-lived perennial, uncommon among rocks on open slopes. W of Copper Basin, just W of divide between Copper Basin and Whipple Wash drainages. 11 Apr 2004 S.J. De Groot 4123.


*Senecio vulgaris L. Rare annual in disturbed sites and along roads; native to Eurasia. Wash and desert pavement along Hwy 95 between Vidal and Vidal Junction. 17 Mar 2003 S.J. De Groot & J.M. Porter 1375.

*Sonchus oleaceus L. Infrequent annual in moist disturbed areas in washes or near open water; native to Europe. Tamarisk grove along Havasu Palms Road. 18 Mar 2003 S.J. De Groot & J.M. Porter 1668.


Stylocline intertexta Morefield. Annual, occasional in sandy washes and on open slopes. Alkaline flat along Parker Dam Road, ca. 1 mi S of Parker Dam. 18 Mar 2003 S.J. De Groot & J.M. Porter 1725.


**Trixis californica Kellogg. Shrub, frequent on rocky slopes and among rocks in washes, generally above 305 m (1000 ft). Old road heading W from Copper Basin, upper Bowman’s wash. 20 Apr 2003 S.J. De Groot & A. Gatto 2455.


**Berberidaceae Juss.


**Bignoniaceae Juss.

**Chilopsis linearis (Cav.) Sweet subsp. arcuata (Fosberg) Hendrickson (Hendrickson 1985). Small tree, small patches scattered in sandy soil of Chemehuevi Wash. Chemehuevi Wash between...

BRASSICACEAE Burnett

Arabis glaucovalvula M.E.Jones. Perennial from root, known from a single collection. Highest peak and ridge running 1.2 air miles to the SW. 6 Apr 1974 J.F. Emmel 477; RSA 297055.

Arabis perennans S.Watson. Rare perennial from root, on rocky slopes above 610 m (2000 ft). Highest peak of summit ridge. 20 Mar 1933 J.F. Emmel 842; RSA 557744.


*Capsella bursa-pastoris (L.) Medik. Rare annual; native to Europe. Roadside; wash and desert pavement along Hwy 95 between Vidal and Vidal Junction. 17 Mar 2003 S.J. De Groot & J.M. Porter 1365.


*Sisymbrium altissimum L. Annual, infrequent on roadsides and disturbed areas; native to Europe. Chemehuevi Wash at junction with Hwy 95, north of Vidal Junction. 5 Apr 2003 S.J. De Groot & L. De Groot 2253.

*Sisymbrium irio L. Annual, occasional in washes and disturbed sites; native to Europe. Canyon along Parker Dam Road, several miles S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M. Porter 1479.

Thysanocarpus laciniatius Torr. & A.Gray. Annual, rare in rocky washes and among boulders on slopes. Cupcake Butte, NW of

mouth and powerline road. 7 Sep 2003 S.J. De Groot & A. Gatto 3128.

BORAGINACEAE Juss.


Cryptantha angustifolia (Torr.) Greene. Annual, frequent in washes and open areas. Bowman’s wash near Parker Dam Road and Crossroads. 20 Apr 2003 S.J. De Groot & A. Gatto 2439.


Tiquilia palmeri (A.Gray) A. Richardson. Suffrutescent perennial, locally frequent in sand dunes and sandy washes. Sand dunes above the Colorado River, N of Crossroads. 23 Apr 1940 A.M. Alexander & L. Kellogg 1212; UC 667400, ARIZ 88074, POM 299184.

VOLUME 24

Whipple Mountains Flora
CARNegiea gigantea (Engelm.) Britton & Rose. Columnar cactus, to about 11 m, scattered on rocky slopes in the eastern part of the mountains. CNPS List 2. Although individuals cover a wide range of height classes, the population may be declining and about 10% of flowers set fruit in 1972 (Brum 1973). Along Black Meadow Landing Road north of Gene Pumping Station, near intersection with Havasu Palms Road. 18 Jul 2003 S.J. De Groot 3053. RSA Living Collection no. 21193.


CYNILDROPTUCA RAMOSISSIMA (Engelm.) Knuth × C. ECHINOCARPA (Engelm. & J.M.Bigelow) Knuth = Opuntia ramosissima Engelm. × O. echinocarpa Engelm. & J.M.Bigelow. Probably = Opuntia wigginii L.Benson (Baldwin et al. 2002). CNPS List 3. Pinkava (2004) lists O. wigginii as a synonym of C. echinocar- pa, apparently being only a dwarf form of the latter. The morphology of specimens collected in the Whipple Mountains is intermediate between C. ramosissima and C. echinocarpa, and warrants further study. The hybrids are rare in bajadas, and generally found much farther west. [Mammillaria dioica K.Brandegee. Botanical Expedition along the Colorado River, Needles to Yuma, Oct. 22 to Nov. 7. Whipple Mts, 130–450 ft. (40–137 m). Full 1912 W.L. Jepson 5228; JEPS 66859. The identification of this specimen was not verified as it was not available for loan. I suspect it was either M. tetran cistra or M. grahamii, as M. dioica is generally found much farther west.]


Mammillaria tetran cistra Engelm. Stem generally 1 (sometimes several), generally hemispheric, occasional in rock cracks or in rocky soil on slopes. Copper Canyon, NE side of range, just upstream from intersection with powerline road. 2 Oct 2004 S.J. De Groot, L. Lubinsky & L.L. Worlow 4402.

Opuntia basilaris Engelm. & J.M.Bigelow. Perennial < 0.5m high, frequent on gravelly or rocky slopes, sometimes at the edges of washes. S of highest peak along wash N of aqueduct, S side of range. 16 Mar 2004 S.J. De Groot & K. De Groot 3713.

CAMANULACEAE Juss.


CARYOPHYLLACEAE Juss.


CHENOPODIACEAE Veni.


Atriplex elegans (Moq.) D.Di etr. var. ELEGANS. Locally frequent annual or short-lived perennial, generally in moist disturbed areas. Bank of ditch at intersection of Parker Dam Road and MWD road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3161.

Atriplex elegans (Moq.) D.Dietr. var. FASCICULATA (S.Watson) M.E.Jones. Locally frequent annual or short-lived perennial, in alkaline soils near the river. Alkaline sink along Parker Dam Road, 1–2 mi S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M. Porter 1468.


*Chenopodium murale L. Annual, occasional in washes and dis-
turbed areas; native to Europe. Whipple Wash, ca. 2.5-hour walk
upstream from powerline road. 17 Mar 2004 S.J. De Groot, K.
*MONOLEPSIS NUTTALLIANA* (Schult.) Greene. Annual, infrequent in
alkaline flats along the Colorado River. Along Parker Dam Road,
1–2 mi S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M.
Porter 1471.
*SALSOLO TRAGUS* L. Rare annual, on road shoulder, in silty alkaline
soil. Along Rahun Trail off Rio Vista Drive. CRIR. 27 Apr 2004
S.J. De Groot 4244.
*SUAEDA MISQUINI* (Torr.) Greene. Shrub, dominant in sandy alkaline
flats along the Colorado River. Cable Car day use area, along

**Convolvulaceae** Juss.
*CUCUTA CALIFORNICA* Hook. *Cucurbita americana* Engel. Rare
parasite, on *Paspalum dilatatum* and *Lythrum californicum* on
rocks at edge of river. Cable Car day use area, along Parker Dam
Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3179.
*CUCUTA DENTICULATA* Engel. Parasite, occasional on various
shrubs, generally at lower elevations. S side of range, along
Chamber’s Well Road near aqueduct road. 4 May 2003 S.J. De
Groot, J.M. Porter, N. Fraga & L. Machen 2741.

**Crossochamaecaceae** Engl.
*CROSSOSISOMA BIGELOVI* S.Watson. Rare shrub, in rocky ravines
generally above 305 m (1000 ft). NW side of Monument Peak, S
side of Copper Basin dunes. 20 Apr 2003 S.J. De Groot & A. Gatto
2472.

**Cucurbitaceae** Juss.
*BRANDEGIA BIGELOVII* (S.Watson) Cogn. Perennial from root, fairly
common in spring, twining over shrubs in washes. Intersection of
Parker Dam Road and MWD/Black Meadow Landing Road.
*CUCURBITA PALMATA* S.Watson. Rare, in sandy soil. 20 mi NE of
Vidal Junction, 8 mi W of Lake Havasu City in Chemehuevi
Wash. 10 May 1978 Faulkner 600; UCR 33636.

**Cyperaceae** Juss.
*CYPERUS INVOLUCRATUS* Rottb. Locally frequent perennial, natu-
ralized into riparian areas; native to eastern Africa. Rock House boat
ramp, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M.
Porter 3152.
*ELEOCHARIS GENICULATA* (L.) Roem. & Schult. Annual, locally com-
mon in boggy areas at the edges of open water. Bass Point, along
Parker Dam Road just N of Colorado River Indian Reservation.
19 May 2003 S.J. De Groot & T. LaDoux 2871.
*ELEOCHARIS PARISHII* Britton. Perennial, frequent on bank of creek in
rocky canyon with flowing water. Gene Wash, up canyon past
3359.

**Scirpum* AMERICANUS** (Pers.) Volkart ex Schinz & R.Keller
(Smith and Yatskievych 1996; Smith 2002) = *Scirpus americanus*
Pers. Perennial from rhizome, locally frequent at the edges of open
water. Copper Basin, N side of reservoir. MWD. 17 May 2004 S.J. De
Groot & L. Lubinsky 4351.
*SCIRPUS CALIFORNICIUM* (C.A.Mey.) Sojak (Smith 2002) =
*Scirpus californicus* (C.Meyer) Steudel. Perennial from rhizome,
locally common in shallows at the edges of open water. Shore of
Lake Havasu, S of Chemehuevi Wash. CIR. 8 May 2004 S.J. De
Groot 4276.

**Euphorbiaceae** Juss.
*CROTON CALIFORNICUS* (Mull.Arg.) Locally frequent perennial, restric-
ted to sand dunes and sandy soils near river. Copper Basin dunes

**OHV area near Echo Lodge, along Parker Dam Road. 26 Aug

**Ditaxis clariana** (Jepson) G.L.Webster. Rare annual or short-lived
perennial, CNPS List 2. Growing on a gravel bar in a dry wash.
8 mi NE of Earp near the Empire Landing Campground. 16 Mar
1980 A.C. Sanders 1158; UCR 21033.

**Ditaxis lancelolata** (Benth.) Pax & K.Hoffm. Subshrub, frequent
in washes or on higher slopes, generally among rocks. Cascade
Mine Road, ENE of Savahia Peak. 5 Oct 2004 S.J. De Groot, L.
Lubinsky & L.L. Worlow 4433.

**Ditaxis neomexicana** (Mull.Arg.) A.A.Heller. Small annual or
short-lived perennial, frequent in washes or on open gravelly
slopes. Ridge near highest peak, above wash N of aqueduct. 15
Mar 2004 S.J. De Groot, K. De Groot, L. Lubinsky & L.L. Wor-
low 3618.

**Ditaxis serrata** (Torr.) A.A.Heller. Perennial, infrequent among
rocks in washes. Just N of mouth of Gene Wash, near Whitset
N. Fraga 3384.

**Euphorbia erianthemata** Benth. Annual, rare in washes in the plains and
bajadas, below 305 m (1000 ft). Chemehuevi Wash at intersection

**Euphorbia micromera** Boiss. (Steinmann and Porter 2002) =
*Chamaesyce micromera* (Boiss. ex Engel.) Wooton & Standle.
Prostrate annual, frequent in or near sandy washes. Vidal Wash
at intersection with Hwy 95, S of Vidal. 28 Sep 2003 S.J. De
Groot & J.M. Porter 3255.

**Euphorbia parviflora** Greene (Steinmann and Porter 2002) =
*Chamaesyce parviflora* (Greene) Millsp. Perennial, frequent among
rocks in washes or near open water. Intersection of Chamber’s
Well and old Needles–Parker road. 16 Jan 2004 S.J. De Groot,
H. & C. De Groot 3526.

**Euphorbia polycarpa** Benth. (Steinmann and Porter 2002) =
*Chamaesyce polycarpa* (Benth.) Millsp. Perennial, common among
rocks or in sand, in or near washes. Wash N of Hwy 62 and
aqueduct, E of old Needles–Parker road. 18 Mar 2003 S.J. De
Groot & J.M. Porter 1573.

**Euphorbia setiloba** Engel. ex Tort. (Steinmann and Porter 2002) =
*Chamaesyce setiloba* (Engelm. ex Tort.) Parish. Prostrate an-
nual, frequent in sandy washes. Middle fork of Whipple Wash,
ca. NW of large dark bluff. 16 Oct 2004 S.J. De Groot & L.
Lubinsky 4473.

**Stillandra linearifolia** S.Watson. Perennial, occasional in large
sand dunes, generally below 305 m (1000 ft). Intersection of
Chemehuevi Wash and powerline road. 19 Mar 2004 S.J. De

**Tetracoccus hali** Frangegee. Dioecious shrub, occasional in
rocky washes in the southern foothills. CNPS List 4. Wash N of
Hwy 62 and aqueduct, E of old Needles–Parker road. 18 Mar

**Fabaceae** Lindl.

**Acacia greggii** A.Gray. Shrub or small tree, common in washes.
Hills and wash between War Eagle Mine and summit ridge. 20
May 2003 S.J. De Groot & T. LaDoux 2932.

**Astragalus cutucostasis** S.Watson. Annual, infrequent on rocky
granitic slopes. Canyon of light colored granite just N of Gene
Pumping Station along Black Meadow Landing Road. 17 Mar

**Astragalus nuttallianus** A.DC. var. imperfectus (Rydb.) Barne-
by. Annual, infrequent on open rocky slopes. Along Havasu
Palms Road, between Black Meadow Landing Road and inter-
section with powerline road. 18 Mar 2003 S.J. De Groot & J.M.
Porter 1583.

**Dalea mollis** Benth. Annual, occasional in washes or on open flats.

**Hymenopappus luteus** Benth. Perennial, in open washes above
Grotto Springs with elevated area. 16 Oct 2004 S.J. De
Groot & L. Lubinsky 21034.
Along powerline road, southern boundary of Chemehuevi Indian Reservation. CIR. 29 Mar 2004 S.J. De Groot 3978.

Dalea mollissima (Ryd.) Munz. Annual, occasional in washes or on open flats. Road along N side of range, past War Eagle Mine; between powerline and mine. 30 Mar 2004 S.J. De Groot 4012.


Lupinus sparsiflorus Benth. Annual, occasional in sandy washes and canyons. Upper Whipple Wash, 4 mi above the powerline crossing. 16 Feb 1986 D. Charlton 15; UCR 41661.


Prospis glandulosa Torr. var. torreyana (L.Benson) M.C.Johnston. Spreading tree, along the Colorado River, often in sandy saline areas, occasionally in mountain washes. Alkaline flat along Parker Dam Road, ca. 1 mi S of Parker Dam. 18 Mar 2003 S.J. De Groot & J.M. Porter 1726.


Psorothamnus fremontii (A.Gray) Barneby var. attenuatus Barneby. Shrub, locally common on slopes below about 915 m (3000 ft). CNPS List 2. Rocky ridge above and E of Whipple Wash along the powerline road. 23 Apr 1983 A.C. Sanders 7373; UCR 31223.


Fagaceae Dumort.


Fouquieriaceae DC.

Fouqueria splendens Engelm. Perennial, in scattered patches throughout the mountains. Road along N side of range, E of intersection with old Needles–Parker road. 21 May 2003 S.J. De Groot & T. LaDoux 2978.

Gentianaceae Juss.


Geraniaceae Juss.


Haloragaceae R.Br.

Myrophyllum sibiricum Kom. Aquatic, locally common in shallows of reservoirs, pools, and at edges of the Colorado River. Bass Point day use area, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3181.

Hydrocharitaceae Juss.


HYDROPHYLLACEAE R.Br.


[NAMA arizonicum J.D.Bacon. Two specimens (UC 667152, UC 667431) were thus annotated in 1984 by John D. Bacon. However, this name apparently has not yet been published, and accordingly these specimens are referred to *Nama demissum*.]


**Phacelia distans** Benth. Annual, common in washes. W of Copper Basin, S fork of Whipple Wash, just downstream from Whipple Cave. 11 Apr 2004 S.J. De Groot 4101.

**Phacelia ivesiana** Torr. Rare annual. Sandy wash, Hank’s Well [West Well], on Vidal–Needles road. 1 May 1932 C.B. Wolf 3196A; RSA 3997.

**Phacelia lemmonii** A.Gray. Rare annual, at base of rocky slope. Copper Basin Reservoir, just inside gate by lake. MWD. 1 Mar 2004 S.J. De Groot 3559.

**Phacelia neglecta** M.E.Jones. Rare annual, growing on desert pavement that occurs between the washes. Four mi due S of the city of Havasu Lake, along the utility road on an alluvial fan. 7 Apr 1978 A.C. Sanders & R. Twitchell 393; UCR 18349.


**Juncaceae** Juss.

**Juncus torreyi** Coville. Locally frequent perennial, in boggy inlet of river. Bass Point, along Parker Dam Road just N of Colorado River Indian Reservation. 19 May 2003 S.J. De Groot & T. LaDoux 2870.

**Krameriacaeae** Dumort


**Krameria grayi** Rose & Painter. Shrub, frequent in washes and on open slopes. Along Parker Dam Road, just N–NE of Cable Car day use area, S of Parker Dam. 25 Apr 2004 S.J. De Groot 4176.

**Lamiaceae** Martynov


**Mentha ×iperita** L. Peppermint. Lone small shrub, escape from cultivation; native to Europe. Sandy alkaline area next to river. Along Hanemo Drive near intersection with Koip Drive, vicinity of Big River. CRIR. 26 Jun 2004 S.J. De Groot, A. Virgen & C. Land 4364.

**Salazaria mexicana** Torr. Shrub, patches frequent in washes. Wash through bajada, N side of range along road past War Eagle Mine. 21 May 2003 S.J. De Groot & T. LaDoux 2977.


**Salvia hoehneana** Greene. Shrub, frequent in small, rocky washes generally above 305 m (1000 ft). Bally Mine, NW slope of Sahavah Peak. 4 May 2003 S.J. De Groot, J.M. Porter & N. Fraga 2818.


**Lilacaceae** Juss.


**Loasaceae** Juss.

**Eunode urens** (Parry ex A.Gray) Parry. Frequent shrub or suffrutescent perennial, often in rock crevices along washes. Bowman’s Wash SE of Copper Basin, near Colorado River Indian Reservation boundary. 21 Apr 2003 S.J. De Groot & A. Gatto 2572.

**Mentzelia affinis** Greene. Annual, occasional in washes and on sand dunes. Just W of Colorado River, Copper Basin Dunes OHV area. 20 Apr 2001 J.M. Porter 12480.


**Mentzelia oreophila** J.Darl. Infrequent perennial, subshrub, often growing on or next to rocks in wash areas. Copper Basin, just outside gate to reservoir. MWD. 12 Apr 2004 S.J. De Groot & R. Snelling 4154.

LYTHRACEAE J.St.-Hil.

LYTHRUM CALIFORNICUM Torr. & A.Gray. Locally frequent on rocks or in mud at the edges of the Colorado River. Cable Car day use area, along Parker Dam Road. 19 Jul 2003 S.J. De Groot 3065.

MALVACEAE Juss.

EREMALCHE EXILIS (A.Gray) Greene. Rare annual, prostrate, in sandy wash. Hank’s Well [West Well], Vidal to Needles. 1 May 1932 C.B. Wolf 3210; DS 282803, RSA 3988.


*SALVIA SPLENDENS* L. Rare annual, disturbed area. Along Parker Dam Road, 12 mi S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M. Porter 1461.


PHAERALcea EMORYI Torr. Sulfurfacescent perennial or subshrub, occasional on rocks or in alkaline soil at low elevations near the Colorado River. Along Parker Dam Road, small clay basin 1–2 mi S of Parker Dam. 17 Mar 2003 S.J. De Groot & J.M. Porter 1472.

MARTYNIACEAE Horan.


MOLLUGINEACEAE Bartl.


OLEACEAE Hoffmanns. & Link


MENODORA SCABRA A.Gray. Shrub, 3 plants seen, 2 in flower and fruit. Gentle slope strewn with volcanic boulders. Along wash E of S fork of Whipple Wash and Whipple Cave, toward Copper Basin and divide. 11 Apr 2004 S.J. De Groot 4113.

ONAGRACEAE Juss.


CAMISSONIA CANDIDISSIMA (Torr.) Raven. Herbaceous or suffrutescent perennial, occasional among boulders in canyons and washes, usually above 305 m (1000 ft). Whipple Wash, ca. 2.5-hour

washes or on sandy road shoulders, generally below 305 m (1000 ft). Ditch at intersection of Parker Dam Road and MWD road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3156.


**Camissonia claviformis** (Torr. & Frem.) Raven subsp. *claviformis*. Annual, infrequent in washes and sandy areas below 305 m (1000 ft). Dune OHV area near Echo Lodge, along Parker Dam Road. 1 Mar 2003 S.J. De Groot & J.M. Porter 1153.


*Gaura parviflora* Lehm. Large bush (about 3 ft) with several long flowering spikes, on flat near the river, 5.5 (5.7) mi N of Cross-roads. 23 Apr 1940 A.M. Alexander & L. Kellogg 1213; UC 1311821, UC 667402.

**Oenothera deltoides** Torr. & Frem. Annual, frequent on dunes and in sandy areas along the river. Just W of Colorado River, Copper Basin Dunes OHV area. 20 Apr 2001 J.M. Porter 12481.


**Orobanchaceae** Vent.

**Orobanchaceae Coopera** (A.Gray) A.A.Heller. Parasite, often on the roots of *Ambrosia dumosa*; infrequent in sandy washes and on dunes. Dune OHV area near Echo Point and Echo Lodge along Parker Dam Road, near Colorado River. 3 May 2003 S.J. De Groot, J.M. Porter, N. Fraga & L. Machen 2740.

**Papaveraceae** Juss.


**Eschscholzia glyptosperma** Greene. Annual, occasional or locally frequent in washes or on open slopes. Wash along western boundary of BLM Wilderness area, S of D&KW mine. 21 Apr 2001 J.M. Porter 12611.


**Eschscholzia parisihi** Greene. Rare annual, edge of wash in southern bajada. Dirt road heading N from Hwy 62 about 9 mi E of Vidal Junction and W of Earp, vicinity of Vista Peak. 5 Apr 2003 S.J. De Groot & L. De Groot 2266.

**Phrymaceae** Schauer


**Plantaginaceae** Juss.


**Poaceae** (R.Br.) Barnhart


*Agrostis semiverticillata* (Forssk.) C.Chr. Perennial, in boggy inlet of Colorado River; native to Europe. Bass Point, along Parker Dam Road just N of Colorado River Indian Reservation. 19 May 2003 S.J. De Groot & T. LaDoux 2867.


**Arundo donax** L. Perennial to 8 m tall, forming clumps along the river in disturbed sites; native to Europe. Rock House boat ramp, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3146.

**Avens sativa** L. Native to Europe. Disturbed area, rocky sand soil. 6 mi N of Vidal Junction, along Hwy 95. 25 Apr 1978 Faulkner 454; UCR 33688.

**Bouteloua aristidoides** (Kunth) Griseb. Annual, common in and near washes. Wash along intersection of Parker Dam Road and MWD road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3154.


**Cenodon dactylon** (L.) Pers. Locally common, naturalized in moist areas near the river; native to Africa. Shore of Lake Havasu, S of Chemehuevi Wash. CIR. 8 May 2004 S.J. De Groot 4275.

**Dasycichla pulchella** (Kunth) Willd. ex Rydfl. (Peterson 2001) = *Erioneuron pulchellum* (Kunth) Tateoka. Perennial, occasional among rocks on slopes. Canyon on NE side of mountains, inter-


LEPTOCILIA PANICEA (Retzius) Ohwi subsp. BRACHATA (Steudel) N. Snow (Snow 1998) = L. mucronata (Michx.) Kunth. Rare annual, on bank of sandy wash, Vidal Wash at intersection with Hwy 95, S of Vidal. 28 Sep 2003 S.J. De Groot & J.M. Porter 3246.


*MUHLENBERGIA RIGENS (Benth.) A. Hitchc. Occasional perennial, recently reported from MWD land (M. Honer pers. comm.). About 2 mi SE of Copper Basin Reservoir, short side canyon ½ mi N of Copper Basin Wash, near powerline running E–W from river to aqueduct tunnel. MWD. 15 Apr 2004 M. Honer & L. Hulse 1952.

*PASPALUM DILATATUM Poir. Perennial, locally frequent in disturbed sites at the edge of the Colorado River; native to South America. Cable Car drive way area, along Parker Dam Road. 19 Jul 2003 S.J. De Groot 3064.


*PHALARIS MINOR Retz. Annual, infrequent in flats and washes, usually near roads; native to the Mediterranean. Along Parker Dam Road S of Bullfrog day use area, across river from Roadrunner resort. 6 Apr 2003 S.J. De Groot & L. De Groot 2339.

PHRAUTHES AUSTRALIS (Can.) Steudel. Locally abundant; recently reported from MWD land (M. Honer pers. comm.). Steep S-facing slopes of chocolate-brown sedimentary rock with rounded river rock inclusions, 1.5 mi SE of Copper Basin Reservoir, and ½ mi N of Copper Basin Wash. MWD. 15 Apr 2004 M. Honer & L. Hulse 1956.


*SCIMUS BARBATUS (L.) Thell. Annual, frequent throughout the mountains; native to southern Europe and Africa. Wash and desert pavement along Hwy 95 between Vidal and Vidal Junction. 17 Mar 2003 S.J. De Groot & J.M. Porter 1390.

*SOREGHUM HALEPELS (L.) Pers. Rare perennial ca. 2 m (6 ft) high, near flowing water; native to Mediterranean. Wash along MWD road near intersection with Parker Dam Road. MWD. 27 Sep 2003 S.J. De Groot & J.M. Porter 3175.


POLEMONIACEAE Juss.


ERASTIUM DIFFUSUM (A.Gray) H.Mason. Rare annual, in shallow wash through bajada, along Hwy 95 6–7 mi N of Vidal Junction, S of Chemehuevi Valley. 5 Apr 2003 S.J. De Groot & L. De Groot 2255.

*ERASTIUM EREMICUM (Jepson) H.Mason. Annual, occasional patches on saddles above 610 m (2000 ft) and on sand dunes near the river. Between summit ridge and War Eagle Mine, top and N-facing slope of ridge near summit. 9 May 2004 S.J. De Groot 4291.

GILIA ANGELINENSIS V.E.Grant. Annual, on the side of a wash. Road to Parker Dam. 17 Mar 1938 R.M. Perkins & H. de Forest 420; RSA 4701. Probably a waif.


LINANTHUS DEMISSUS (A.Gray) Greene. Rare annual, rocky canyon 5.5 mi NW of Whipple Wash along the utility road. 7 Apr 1978 A.C. Sanders & R. Twitchell 527; UCR 18412. May come up only when the area receives normal or more than normal rainfall.


POLYGONACEAE Juss.


CHORIZANTHE CORRUGATA (Torr.) Torr. & A.Gray. Annual, locally frequent in washes or on gravelly slopes. S side of range, along


POLYGONUM HYDROPEROIDEIS Michx. Infrequent perennial, in saline flats along river. Foot of mountains, along the Colorado River. CRIR. 18 Nov 2001 J.M. Porter 13366.


POTAMOGENONACEAE Rchb.

*POTAMOGETON CRISPS L. An occasional submerged aquatic floating in the river. Along the Colorado River at Big River, SW of Earp. CRIR. 15 Nov 1980 A.C. Sanders 2041; UCR 23016.

POTAMOGETON NODOSUS Poir. Aquatic perennial, occasional in shallows at edges of open water. Rock House boat ramp, along Parker Dam Road. 27 Sep 2003 S.J. De Groot & J.M. Porter 3148. An additional vegetative specimen was collected which may be P. nodosus, or may be a different species (R.E. Thorne pers. comm.); Gene Reservoir. MWD. 10 Oct 2003 S.J. De Groot & J.M. Porter 3351.


RANUNCULACEAE Juss.

ANEMONE TUBEROUSA Rydb. Perennial from root, rare on slopes and in washes, above 305 m (1000 ft). Along Whipple Wash 0–4 mi upstream of the powerline road. 15 Mar 1980 A.C. Sanders & J. Zabriskie 1151; UCR 22517.


RESEDAEACEAE Bercht. & J.Presl.


RHAMNACEAE Juss.


ROSACEAE Juss.


RUBIACEAE Juss.


RUTACEAE Juss.


SALICACEAE Mirb.


SALIX EXigua Nutt. Small tree or shrub forming thickets ca. 2–4 m high, occasional at edges of the Colorado River. Shore of Lake Havasu, S of Chemehuevi Wash. CRIR. 8 May 2004 S.J. De Groot 4273.


SCROPHULARIACEAE Juss.


*BACOPA MONNIERI (L.) Wettst. Aquatic herb, locally common in
mud at edges of the Colorado River. Bass Point day use area, along Parker Dam Road. 26 Aug 2003 S.J. De Groot 3083.


**Penstemon pseudospectabilis** M.E.Jones. Suffrutescent perennial, infrequent among rocks in washes or on slopes, generally above 305 m (1000 ft), Copper Basin, just outside gate to reservoir. MWD. 29 Mar 2004 S.J. De Groot 3961.

**Smaragdaceae DC.**

**Castela emoryi** (A.Gray) Moran & Felger. Large shrub, clump of ca. 11 plants, some 2–3 m high, in gravelly and sandy alluvial soil. CNPS List 2. Chemehuevi Wash, just N of wash, a few miles E of Hwy 95. 25 Apr 2004 S.J. De Groot 4185. Technically out of the study site, but so close to the line that I included it. Potentially it could occur S of the wash as well.

**Solanaceae Juss.**

**Datura discolor** Bernh. Summer annual. Occasional in small wash along road between Vidal and Big River (roughly following the Atchison, Topeka, and Santa Fe Railroad tracks), just E of Travel at Your Own Risk sign. 9 Oct 2003 S.J. De Groot, J.M. Porter & L. Machen 3266.

**Datura wrightii** Regel. Three ft. high & spread, stem 1.5 in. Sun, sandy wash of open valley. Hank’s Well [West Well], on Vidal–Needles road. 1 May 1932 C.B. Wolf 3216; RSA 4017.


