

Plants Found Along the Effluent Dominated Stretch of the Middle Santa Cruz River

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Introduction

Water was sustainably harvested from the Santa Cruz River before European settlement by the native Hohokam peoples in what is now southern Arizona for hundreds of years. These people cultivated edible crops utilizing carefully engineered mud lined irrigation canals (Logan 2002). During this time the Santa Cruz River ran perennially and supported an abundant and vast riparian ecosystem. This riparian forest system contained such regionally extinct species as the muskrat, wild turkey, beaver as well as a variety of native fish. In addition its waters supported abundant and vast cottonwood, mesquite, and willow forests. Unsustainable water harvesting, deforestation, overgrazing, introduction of plant cultivars and their accompanying insect communities, erosion, and desertification begun in the middle 1800's by new Spanish urban settlers marked the start of the decline of the Santa Cruz River ecosystem (Logan 2002). By 1940 groundwater pumping from the Tucson basin's aquifers had lowered water tables past the reach of even the great cottonwood's massive root systems and the river's remaining riparian vegetation began to die (Figure 1).

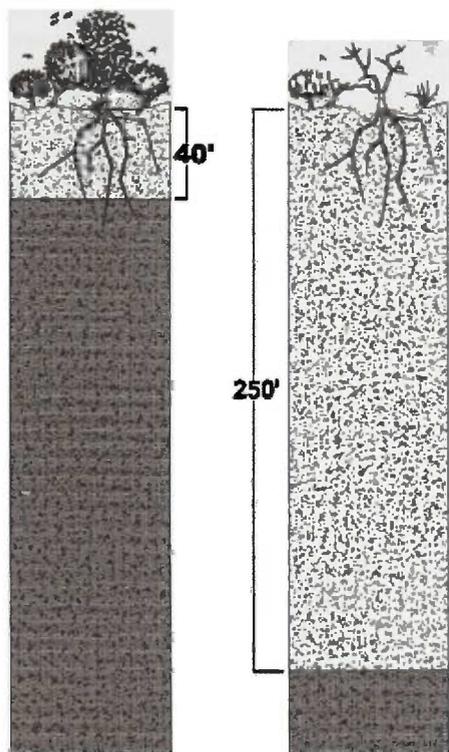


Figure 1. Two hundred years ago the groundwater table was less than 50 feet below the surface. By 1923 groundwater usage rates had surpassed recharge rates (Nabhan 1999). Today the groundwater table is 200 - 250 feet below the surface (Fabre 2009).

In 1977, in an effort to recycle reclaimed wastewaters and to partially re-charge the Tucson basin aquifer, Pima County began releasing treated wastewater or effluent waters into the Santa Cruz at Roger and Ina Roads. These running waters led to the partial rehabilitation of over 30 miles of the Santa Cruz starting at Roger Road. As a result a unique, effluent dependent, riparian ecosystem has developed with high biological diversity and a complex vegetation mosaic. This article is an attempt to identify and describe the plant life in the area. Although not comprehensive this article is the most complete collection of the vegetation which exists describing this unique ecosystem known to the author. It describes just over 100 species identified by the author during graduate research and casual observations or by others for catalogue in the University of Arizona Herbarium.

As part of thesis work in April and May of 2002, vegetation data was collected in 23 belt transects selected randomly along 4 different river type environments of the greater, middle Santa Cruz River. The purpose of this research was to gather enough plant data to be able to show, with statistical significance, the effects of the release of effluent waters on the vegetation of the severely debilitated Santa Cruz River. This was done using such biological measures as density, richness, diversity, cover, even-ness, and nativity (Figure 2). The results of this initial study were published in a thesis entitled, "Changes in Riparian Vegetation Following Release of Reclaimed Effluent Water into the Santa Cruz River: As a Corollary, the Effects of Channelization on the Vegetation in the Santa Cruz". One aspect of the work of this initial study was to count and identify individual plant species. A total of 60 plant species were identified in study transects along the effluent dominated stretches of the middle Santa Cruz during this initial thesis work.

The purpose of this report is; 1) to provide a photographic and written description of the vegetation identified and recorded in the effluent dominated middle Santa Cruz River by the author and others as recorded at the University of Arizona Herbarium, 2) to identify and describe predominant species of the area 3) to describe some of the unique attributes of the plants in this unique ecosystem, 4) to signify poisonous plants and occasionally identify their active secondary compounds, 5) to signify plants which were also identified and recorded by J.J. Thornber in the Santa Cruz watershed over 100 years ago, 6) to distinguish between nativity and dependence on effluent waters in an effort to describe plant life which might be termed as restored to the area as a result of effluent release and Thornber's identification prior to 1910, 7) to identify additional riparian native plants which can be assumed to be restored to the area.

Materials and Methods

As part of the work of the original study transect locations were randomly selected in 4 designated study areas; 1) areas with effluent waters, 2) areas without effluent, 3) channelized areas with effluent and 4) channelized areas without effluent. (Figure 3). A total of 23 transects were randomly selected and data was meticulously gathered in each. In total over 14,000 individual plants were identified and counted and a total of 71 different plant species named. Ten of the original 23 transects were in areas which contained effluent waters as were 60 of the original 71 identified plant species.

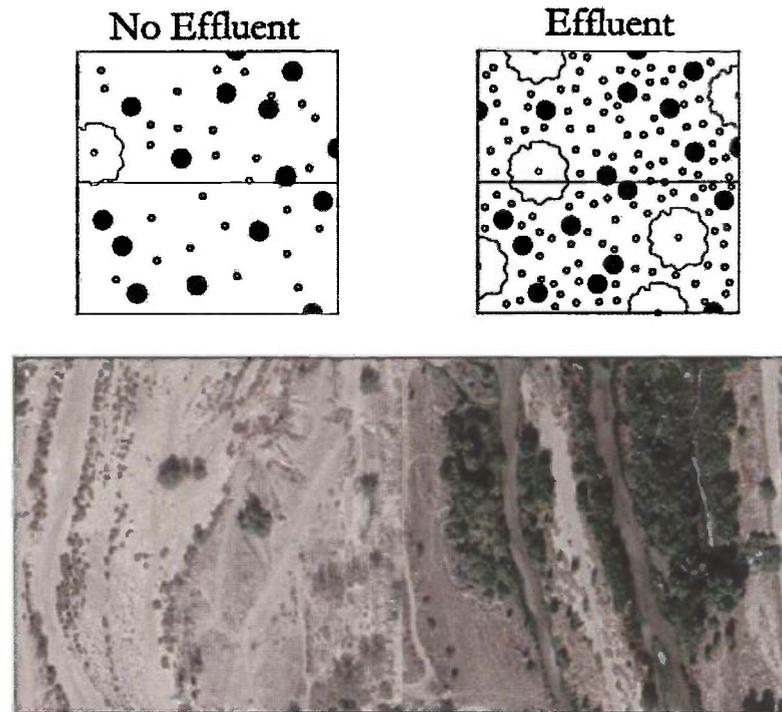


Figure 2. Santa Cruz River: Vegetative cover in the effluent affected stretch. (Gormally, 2002)



Figure 3. River Transects: Transects 25.5 feet wide bank to bank. See dirt road right of river effluent water for a sense of scale. (Aerial image courtesy of Google Earth.)

The data was collected in belt transects which were just over 25 feet wide and as long as the river was wide. In one case this was greater than the length of two football fields put end to end. Not surprisingly, the transect with the highest plant density occurred in an effluent dependent reach of the river and contained just under 936 individual plant specimens in an approximately 7,300 square foot belt transect. The transect with the highest number of plants was located in an especially wide river section containing effluent. This transect had over 1900 plants in an area just under 19,000 square feet. The transect with the least plants, a count of 88, was located in an un-channelized and severely debilitated river section located south of downtown Tucson approximately 250 feet upstream of the Irvington Road bridge.

Plants identified and recorded at the University of Arizona Herbarium in the middle effluent dominated stretch of the Santa Cruz are also listed. An original plant list from the Herbarium's Santa Cruz River database of 736 plants was filtered based on a number of criteria developed by the author in order to distinguish between those

found in the lower effluent dependent plant ecosystem. These plants from the UA Herbarium Santa Cruz database were cross referenced for date of identification, latitudinal and longitudinal location, descriptive location, and presence of effluent. The author identified forty three plants catalogued in the herbarium as effluent dependent under the above guidelines and they are included here.

Plants found in non-effluent dependent stretches of the river will not be covered in this manuscript. The plants of this ecosystem were covered in "Desert Plants", Volume 18, Number 1, entitled "Plants of the Santa Cruz Valley at Tucson" by Kathryn Mauz June 2002. Another related "Desert Plants" article entitled "Herbaceous Exotics in Arizona's Riparian Ecosystems", Volume 13, Number 1, June 1997, describes 70 common native and exotic plants found in Arizona's riparian areas. Interestingly, only 25 of these 70 have been found in the lower effluent dependent Santa Cruz plant ecosystem to date.

Describing the Area

The stretch of the Santa Cruz River located in and around the Tucson basin is generally referred to as the middle stretch as it is in the approximate middle of the river's course. The area containing flowing effluent may then be termed the effluent dominated middle Santa Cruz river. There are two major flows of effluent in the Santa Cruz River. One is from the town of Nogales and the other further downstream is from the Tucson area. For this reason vegetation in the middle Santa Cruz in areas containing effluent might be referred to as the lower effluent dependent Santa Cruz vegetation.

Symbols Legend

NT = Native Tree, ET = Exotic Tree, NW = Native Woody Shrub, EW = Exotic Woody Shrub, NH = Native Herbaceous, EH = Exotic Herbaceous.

P signifies a predominant species.

SpecSig signifies a plant marked for recognition by Phil Jenkins, University of Arizona Herbarium Plant Specialist.

:X: marks a highly poisonous or deadly poisonous plant species.

T-1909 represents plants which Thornber identified in the Santa Cruz watershed prior to 1909, (Mauz 2002). Thirty two of these plants were identified in the lower effluent dependent reach. Of these 32, 10 can be said to be native plants dependent upon the additional water supplied by effluent.

RTA signifies a native species which might be assumed as "restored to area" due to its dependence on supplemental water for survival. Of 103 species identified in this article 24 are assumed to be RTA.

IFS denotes those plants which have traditionally served as a food source to Native American peoples.

OIU denotes other indigenous uses such as medicinal and tactile.

CLP indicates a commonly used landscape plant. Due to the high water availability in the area, various native and exotic landscape plant species occur in the area.

ARIZ##### signifies a plant specified as found in the effluent dependent lower Santa Cruz River by the University of Arizona Herbarium, (ARIZ) and its corresponding specimen number (#####). If the specimen number is followed by an * the plant was also identified and recorded by the author.

Plants found in the lower effluent dependent Santa Cruz river ecosystem: Alphabetical by plant type.

Trees

Acacia constricta, Whitethorn Acacia, NT, CLP

This desert native is a common tree in the Sonoran Desert landscape. Its yellow balls are very fragrant and abundant pollinating sources. When pruned this tree has a very attractive appearance and is a common choice in designed landscapes (Bowers 1993).

Acacia greggii, Catclaw Acacia, NT, :X:, T-1909, IFS, OIU

Like the whitethorn, the catclaw acacia is a southwestern United States desert native. Also called the catclaw mesquite, tear blanket, Gregg's catclaw, devil's claw, paradise flower, wait-a-minute, wait-a-moment, and wait-a-bit tree, the *Acacia greggii* has unique and extremely sharp cat claw-like thorns. The genus name *Acacia* means thorny and the species name of *greggii* is derived from the root name of Josiah Gregg, an amateur naturalist of the early 1800's. This tree is normally a smaller one in comparison to other desert natives however mature trees sometimes reach heights up to 50 feet. Like the whitethorn, its flowers are puffy yellow balls

which are a favorite of nectar collecting insects. The fragrant yellow puff balls appear April through October (Leake 1993). The seeds have been ground into flour and the pods eaten raw or cooked by native peoples for centuries. Its very dense wood has traditionally been used for stock in home and tool construction (Petrides 2005).

Cercidium floridum or *Parkinsonia florida*, Blue Palo Verde, NT, IFS, CLP

Named after the Greek word, *kerkidion*, for weaver's comb, plants in the genus *Cercidium* produce seeds with a unique segmented shape resembling these historically common tools, (Lamb 1975). Another unique attribute of the blue palo verde is the fact that it contains chlorophyll in its bark allowing it to conduct photosynthesis along its trunk and branches as well as its leaves. The chlorophyll gives trees in the *Cercidium* family a greenish, greenish yellow or greenish blue color (Yetman 2009). As the name implies the blue palo verde has a bluish color to its bark. It is a common Sonoran Desert tree most often found in and near riparian areas. Like its relative below, the *C. floridum* has a dense, low growth pattern and is twiggy with an unusually abundant spring bloom which often covers the entire tree (Jones 2000). Trees in full bloom often appear to be made of solid yellow leaves and stems until inspected up close and found to be covered in thousands of tiny yellow flowers. After pollination there is an abundance of seeds which were a food source for indigenous Native American people, (Petrides 2005).

Cercidium microphyllum or *Parkinsonia microphylla*, Foothills Palo Verde, NT, IFS, CLP

Also called yellow palo verde, this predominant native tree, is more likely to be found, as its common name implies, on higher and drier ground. The scientific name of *microphyllum* describes prolific and tiny leaves. It is a hardy, slow growing plant, found below 4000 feet (Duffield & Jones 1981), native to the Sonoran Desert in the United States (Jones 2000). It has an impressive yellow spring bloom. The flowers from this bloom are a good nectar food source for many insects (Leake 1993). Like the Blue Palo Verde, its seeds were an important native food source, and their preparation included roasting, grinding, and soaking (Yetman 2009). Both the blue and foothills palo verde trees are excellent native landscaping trees as they are sculpturally attractive, uniquely colored, prolific flowering plants, which provide habitat and food for native wildlife.

Nicotiana glauca, Tobacco Tree, ET, :X:, T-1909, OIU

This smaller tree has smooth white bark and large dark blue-green leaves. The plant is a close relative to the common tobacco plant and contains many of the same toxic chemicals such as nicotine and other alkaloids which makes plants in this family extremely poisonous. Although not predominant, the plant is relatively common along the effluent dependent lower Santa Cruz and its large darkly colored leaves make it easily distinguishable from other vegetation in the area. Like the common tobacco plant, all parts of the plant can be deadly if ingested (Schmutz 1979). Several deaths were recorded when young plants were mistaken for spinach, cooked, and then consumed. This deadly exotic plant is a native of Argentina. Among over a dozen symptoms of ingestion are nausea, severe vomiting, cold sweats, convulsions and death due to respiratory failure (Schmutz 1979, Wink 2008).



Nicotiana glauca

***Olneya tesota*, Ironwood, NT, IFS, OIU**

Ironwood has one of the strongest, densest, and heaviest woods of any tree in the world. This unique tree is thought to live as long as 900 years. Its trunk can survive decomposition another 1000 years after plant death (Yetman 2009). Due to their slow growth and unique wood, ironwoods cannot be dated using the traditional tree ring method. Their age is calculated using carbon dating methods. Although not as common as the velvet mesquite and native palo verdes, it can often be found as a predominant tree in various regions around Tucson and in the Sonoran Desert. One such area is the Ironwood National Monument west of Tucson. Its seeds can be roasted and eaten (Lamb 1975) and they were an important food source for many indigenous desert people (Yetman 2009). The wood was used to make very hot fires and load bearing beams in home construction. *Olneya tesota* can be found in Arizona, California, and northern Mexico (Yetman 2009).

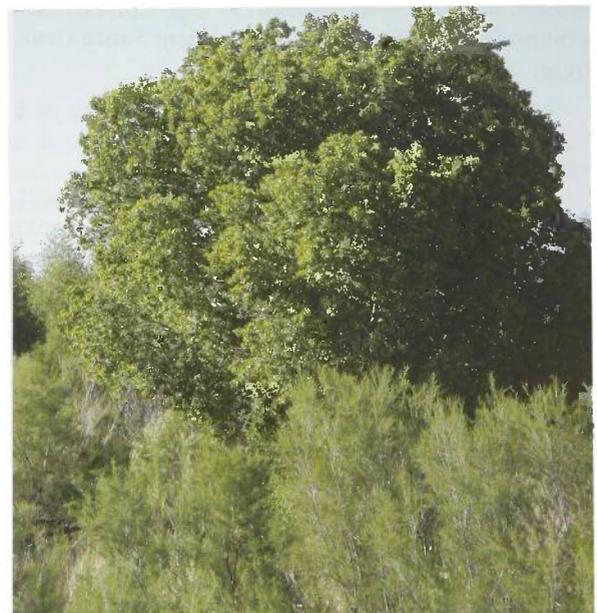
***Parkinsonia aculeata*, Mexican Palo Verde, ET, IFS**

Considered an invasive weedy species by many Southwest plant experts, the exotic Mexican palo verde tree is a common occurrence in the landscapes of the City of Tucson. This aggressively invasive species can be distinguished from its relatives the blue

and foothills palo verdes, by its long willow-like leaves and associated abundant litter. This tree has now naturalized into many disturbed and urban areas. Like the other palo verdes found in the area, its seeds were a food source of indigenous peoples of its range (Yetman 2009).

***Populus fremontii*, Fremont Cottonwood, NT, T-1909, RTA, IFS, OIU** Also called Fremont poplar, Arizona cottonwood, MacDougal cottonwood, and the alamo, the *Populus fremontii* is an extremely large riparian tree. It was once abundant along most of the Santa Cruz River in a vast and prolific riparian forest which contained wild turkey, beaver, and muskrat. In the desert Southwest it is always a sight to see due to its sheer size, bright green leaves, and assumed proximity to water. The cottonwood uses relatively large amounts of ground and surface water and is habitat to many bird species including large raptors such as hawks and owls. Cottonwoods can grow to 100 ft. tall with a trunk 5-6 feet in diameter and with a comparably vast and deep root structure (Vines 1960). It is a source of foraging food for herbivores such as mule deer, sheep and elk and was used by Native American people as a food source, for medicinal purposes, and as construction material for baskets and other tools, (Vines 1960). The trees buds or catkins are edible and its bark is thought to have curative powers for healing bruises, sprains, and broken bones (Yetman 2009). Cottonwoods grow at elevations lower than 6000 ft. (Duffield and Jones 1981).

The forests of cottonwood and willow that thrived along the Santa Cruz prior to European settlement disappeared in the early 20th century as surface waters disappeared and water tables dropped. Along the now barren stretches of the Santa Cruz southeast of the I-19 crossing and San Xavier Cathedral all that is left of their existence are large holes in the ground which are the voids left after the death and decomposition of their great root systems. Although not predominant, cottonwood trees are beginning to thrive in the lower effluent dependent Santa Cruz. They serve as valuable nesting habitat to various raptor species and as a hint of the former riparian forests of the Santa Cruz.



Populus fremontii



Voids where cottonwoods once grew

Prosopis hybrid, South American Hybrid, ET, CLP

Unlike its Sonoran Desert relative the velvet mesquite, the South American hybrid is a non-native, semi-aggressive, invasive, species. Introduced for its fast growth rate and favorable size the South American mesquite has begun to naturalize into disturbed and urban areas. Along the effluent dominated lower Santa Cruz it can be found alone or in groups of two or three. Unfortunately, this plant has been used frequently in the desert landscape as it grows rapidly with relatively little water. Drawbacks to its use and maintenance are its large and sharp thorns, its likelihood of falling over in heavy storms due to its fast and often top heavy growth and its less favorable habitat value to native bird species.

Prosopis velutina, Velvet Mesquite, NT, T-1909, IFS, OIU, CLP
Commonly known as velvet mesquite, this tree is one of the most important trees of the Sonoran Desert. 'Velutina' refers to the velvety quality of its leaves. It is one of the most predominant in the region and serves as habitat for its own unique fauna. Its seeds have been used as a food source by wildlife and native peoples for thousands of years and it is an excellent native landscaping tree. It is often found in and near riparian areas in large groupings called mesquite bosques. These riparian ecotopes serve as unique habitat for many types of birds and small mammals of the region (Lamb 1975). Bosques were a common phenomenon along the Santa Cruz prior to the riparian ecosystem collapse in the late 19th and early 20th century, the result of unsustainable water harvesting.

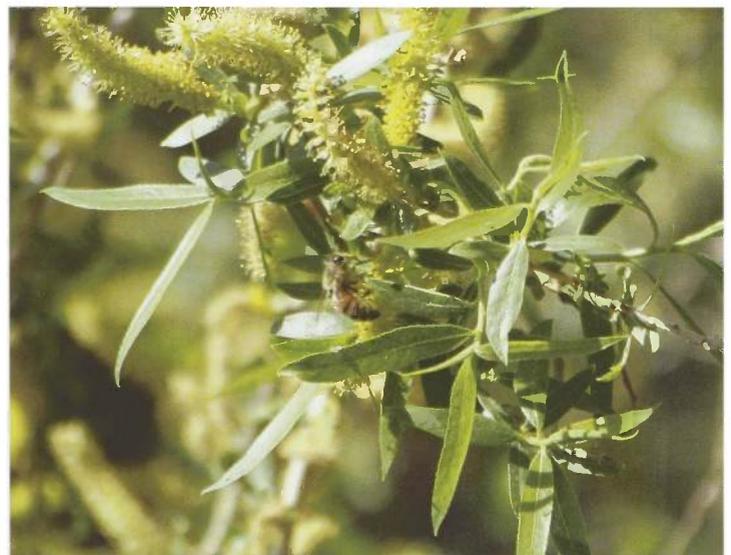
The mesquite bean was the foundational starch food source in the diet of many native peoples and the sap which oozes from the tree is sweet and edible. It was considered a treat or natural candy by many indigenous groups. It also served a functional role as an adhesive, filler, and as an all-purpose resin. The roots, bark, sap, and leaves all served medicinal roles in traditional Southwest medicine. These plant parts were used to cure conjunctivitis, intestinal parasites, acne, and dandruff (Yetman 2009). The wood of mesquite releases a favorable smell and flavor when smoked and has therefore been used in the smoking of meats. Unfortunately, there has been little restoration of the historical mesquite bosques which once existed along the water course due to effluent release into the Santa Cruz and its occurrence here is relatively low when compared to its abundance in other Sonoran Desert regions.

Salix gooddingii, Goodding Willow, NT, P, SpecSig, T-1909, RTA, OIU, ARIZ 193844*

The Goodding willow is the most common tree species found in the effluent dependent reach of the lower Santa Cruz. It can be found lining the stream course in most areas where there is effluent. Like the Fremont cottonwood, the Goodding willow was a predominant and integral part of the once prolific riparian forests of pre-Spanish colonization. As an integral and predominant species it provided food and habitat for many animal species. It was a common food source of locally extinct beavers and would have been utilized often for dam building along the pre-settlement Santa Cruz River ecosystem (Allen 1983, Glinski 2002). This native tree species seems to have benefited the most from the release of effluent into the lower Santa Cruz River as thin riparian forests of Goodding willow can be seen along its banks for miles. There were an average of 12 trees per effluent study transect easily making it the most common effluent dependent tree. If effluent release is continued and barring any major flood events, 50 foot Goodding willow trees will dominate much of this stretch of river ecosystem in less than 10 years providing a substantial partial river restoration and considerable riparian habitat.

In some areas the trees are often as tall as 30- 40 ft. and are habitat for owls, hawks, and song birds in addition to the endangered willow flycatcher (Yetman 2009). They can grow as tall as 50 ft. with trunks as wide as 2-3 ft. in diameter, (Lamb 1975). This willow is a natural source of acetylsalicylic acid or aspirin, and was therefore a favorite painkiller of Native American healers (Yetman 2009). *S. gooddingii* can be found in California, Arizona, Nevada, Texas, Colorado, New Mexico, and Utah, (USDA).

Spec Sig: According to Phil Jenkins Goodding willow is perhaps the most important plant in southern Arizona that indicates the presence of a permanent water source. Its presence is an indicator of a habitat that is suited for such fauna as flycatchers, vireos and warblers.



Salix gooddingii

Tamarix ramosissima, Salt Cedar, ET, P

Also known as Manna-Bush, Athel, Eshel, Asul, Athul, and Atle, this is the second most predominant tree in the effluent dependent region. This aggressive and often un-desirable invader from Africa and the Middle East, out-competes many native trees for vi-

tal riparian waters not only in this area but across the Southwest (Duffield and Jones 1981). It is a large tree easily reaching heights of 40 feet and greater. It was originally cultivated as an ornamental, erosion, and wind break plant in Texas and the Southwest, but now chokes many southwestern riparian areas (Vines 1960). One positive to its occurrence in the area is that its dense foliage and large size serves as excellent plant cover and bird habitat. Another drawback to the salt cedar is the fact that it has allelopathic properties which prevent understory growth.

Woody Shrubs

Ambrosia aptera, Ragweed, NW, RTA

Plants in this genus are commonly found in desert regions and are often uniquely adapted for dry climates. The ragweed is somewhat of an exception as its relatively large leaves require more water than other plants in the genus (Bowers 1993). Therefore it prefers and can often be found in riparian areas. The pollen from these plants are known allergens. *Ambrosia aptera* contains sesquiterpenes and sesquiterpene lactones which are moderately hazardous secondary compounds causing neurotoxicity and allergic reactions (Wink 2008).

Arundo donax, Giant Reed, EW, P, T-1909, IFS, OIU

Also known as canegrass, this grass has competitively pushed the native canegrass, *A. phragmites*, out of Sonoran riparian areas (Yetman 2009). The two plants closely resemble each-other with tall 8 – 12 foot vertical structures similar to bamboo. *Arundo donax* so closely resembles its native counterpart that the two plants can only be distinguished by the most skilled plant expert (Yetman 2008). The young shoots of both plants were an early food source of indigenous peoples. Its roots were used to make healing teas for various ailments and its hollow stems to make musical wind instruments. Its dense thickets offer shelter, food, and protection to many wildlife species (Yetman 2009). It also contains bufotenin, tryptamines and tyramines which are moderately hazardous hallucinogenic and mind altering compounds (Wink 2008). This plant often dominates along the banks of the lower Santa Cruz effluent dependent ecosystem in thick and tall stands.



Arundo donax

Atriplex canescens, 4-Wing Saltbush, NW, T-1909, IFS, OIU

Also known as wingscale, this plant is unique for its color and texture. It is a silvery grey and covered with small scales. It is a popular foraging plant for deer, sheep, and other large herbivores. Along the effluent dependent water course it is most commonly found as an edge species. It has also been used as a preservative, yellow dye, salt flavored seasoning and as medicine by indigenous peoples of the region. It was said to heal stomach pain, infections, and toothaches (Yetman 2009). Its seeds can be ground into an edible meal and its roots and flowers, when combined with saliva, into a healing ointment for insect bites (Leake 1993).

Atriplex cf. lentiformis, Saltbush, NW

This plant, also known as quail bush, big saltbrush, big saltbush, quailbrush, lenscale, len-scale saltbush and white thistle is most commonly found along coastal Californian landscapes but is native to the Sonoran Desert (USDA, Calfora).

Baccharis salicifolia, Seepwillow, NW, *SpecSig*, T-1909, OIU, ARIZ 191266*

Also called pursh, this is a native stream bank shrub with willow-like leaves and long straight stems. Native American people used the plant's branches to make arrows and its leaves as odor absorbers and deodorants. The leaves were also used to make a contraceptive tea for women (Yetman 2009). The plant flowers from February through May. Its range is from sea level to 5000 ft. in West Texas, New Mexico, Arizona, California, and South America reaching as far southward as Chile (Vines 1960).

Spec Sig: According to Phil Jenkins, seepwillow is a shrub or small tree that indicated the presence of underground water.

Baccharis sarathroides, Desert Broom, NW

This common desert shrub can be found predominating almost every disturbed piece of land in the Tucson area. Its unique leafless structure allows it to begin all-out photosynthesis through its stems immediately after rains, beating most traditional plants which must first produce new leaflets prior to beginning photosynthesis (Bower 1993). Another mechanism which assists the plant to outcompete others is its abundant and feathery seed pods which distribute themselves readily and by large numbers through the air.

Caesalpinia gilliesii, Yellow Bird of Paradise, EW, CLP, T-1909

This relatively common landscape plant native to South America has a showy yellow and red flower (Duffield and Jones 1981). Interestingly, Thornber identified this plant prior to 1909, making it one of a number of historical ornamentals.

Celtis pallida, Desert Hackberry, NW, T-1909, IFS, CLP

This unique desert native is a valuable plant with many important ecological roles in the desert ecosystem. Its edible fruits are eaten by coyote, javelina, rabbit, and bird species. Its leaves food for differing butterfly larva and mule deer. Its size, thickness and spiny nature afford ideal nesting cover for desert quail and dove. The Sonoran Desert represents the northernmost reach of this plants home range as it is a sub-tropical and tropical plant stretching southward into Central America and Argentina (Bowers 1993). Due to its many favorable qualities this plant makes an ideal desert native landscaping choice.

***Cupressus* species (unidentifiable)**

Plants in this genus are evergreen trees or shrubs with dense foliage and coned fruits (USDA).

***Cylindropuntia leptocaulis* x. *spinosior*, *Opuntia leptocaulis*, Desert Christmas Cactus, NW, IFS, ARIZ 124747, 126350**

This native cactus derives its common name from its green branches and red fruits which are on display around Christmas time (Kearney 1960). Native peoples of the region have traditionally harvested and eaten the fruits from this spiny cactus (USDA).

***Cylindropuntia spinosior* or *Opuntia spinosior*, Cane Cholla, NW, ARIZ 126328**

This common and widely distributed Sonoran Desert cholla species, like all chollas, provides cover to songbirds from predation. It also supplies a valuable fruiting food source to many animal species (Bower 1993).

***Encelia farinosa*, Brittlebush, NW, CLP, OIU**

This small flowering shrub is often planted for its attractive and hardy nature as a low water landscape plant and as a seed plant in seed mixes for revegetation efforts in southwest Arizona. It is native to the Sonoran and Mojave Deserts and displays beautiful abundant yellow flowers in the spring and at other times (Jones & Sacamano 2000). The gum which oozes from the stems of this plant can be used to make incense. It was used by Catholic priests for this purpose for centuries. Native American peoples chewed and heated the plant's gum to be applied as a pain-killing and healing ointment (Leake 1993). Care should be taken as it is poisonous and contains dangerous sesquiterpenes which are moderate cell and neuro-toxins (Wink 2008).

***Hymenoclea momogyra*, Burrobush, NW, :X:**

Also known as romerillo, cheeseweed and jecota, this plant has a cheesy smell when its leaves are disturbed. This bright green desert shrub is often clustered together in thickets and occurs in the Southwest below 4,000 ft. It can be found from western Texas to southern California and down into northern New Mexico (Dodge 1985). It contains moderately dangerous cell toxins, neurotoxins, and allergens (Wink 2008).

***Isocuma tenuisecta*, Burroweed, NW**

This is a hardy and poisonous pioneering species which cattle will avoid. As a result the plant often dominates grazed areas. It can often be found along parking lots and in other disturbed areas. This desert native has tiny yellow flowers which make for a somewhat showy display in late summer and early fall (Bowers 1993).

***Larrea tridentata*, Creosote, NW, CLP, :X:, OIU**

The most widespread desert plant (Leake 1993), also known as chaparral leaf, greasewood, hedionilla, gobernadora, and guamis, creosote has numerous unique uses and qualities. It can survive on very little water and often predominates an ecosystem, almost to the point of being a monoculture. When this occurs, often in flat, poor soil and low water areas, the resulting biome is called a creosote flat. The plant itself emits a very strong smell after rain which permeates the air. Its body is covered with a sticky resin and its fruits are covered in white hairs. It is home to multiple insect species including a midge which makes leafy galls on its limbs (Lamb 1975). It has many indigenous uses as paint, dye, medi-

cine for rheumatism and burns, food flavoring, and as a perfume (Leake 1993). Creosote is poisonous and contains lignans such as nordihydroguajaretics which are cytotoxic and can cause nausea, vomiting, diarrhea, and abdominal pain if consumed (Wink 2008). Yetman (2009) claims that some plants may be as old as 12,000 years, which could make creosote the oldest living plant on earth.

***Lycium andersonii*, Anderson Wolfberry, NW, T-1909, ARIZ 211464**

Known as Anderson thornbush, Anderson lycium, Anderson desert thorn, Anderson boxthorn, Tomatillo, and desert tomato, this Sonoran Desert native plant can form thickets in riparian washes. Unique in its form with spiked branches which get larger further from the main stem, this plant provides an almost impenetrable wall of thorns which sometimes prevents birds from entering. Fruits which are sometimes prolific are very bitter and have been used as a food source by indigenous peoples (Kearney 1960).

Opuntia* x. *tetracantha*, ARIZ 126264**Panicum antidotale*, Blue Panicgrass, EW, ARIZ 108811**

This plant is classified as a noxious weed by the California Department of Food and Agriculture (USDA).

***Penisetum ciliare*, Buffelgrass, EW, P**

This highly invasive and aggressive large grass species from Africa, Asia, India and the Middle East can quickly out-compete native plants in the Sonoran Desert. It is a threat to ecosystems across southern Arizona. Recently, community and government groups have banded together to remove buffelgrass from various ecosystems including the study area. Since data was gathered in 2002 buffelgrass numbers have increased significantly in effluent and non-effluent sections of the middle Santa Cruz (USDA, Gormally 2002).

***Typha domingensis*, Southern Cat-tail, NW, P, RTA**

Also known as cumbungi, this native aquatic plant can be found in dense thickets at the edge of flowing and standing waters. It is a predominant species among the lower effluent dependent Santa Cruz vegetation and forms long and dense thickets up to four feet tall (USDA).



Typha domingensis

Herbaceous Plants

Apium leptophyllum or *Cyclospermum leptophyllum*, Marsh Parsley, **EH, ARIZ 193857**

This small herb is a member of the celery family and is notable as a common garden weed as well as for its similarity in appearance to parsley (Munz 1974).

Argemone ochroleuca, Sweet Pale, **NH, RTA, ARIZ 193849**

Also known as Mexican pricklypoppy, this plant is a native annual with thorny thistle-like leaves and showy flowers (USDA).

Asteraceae species (unidentifiable)

Commonly referred to as the Sunflower family, plants in the Asteraceae are generally herbaceous and flowering. (Calflora)

Bidens cernua, Spanish Needles, **NH, RTA**

This small native herb has a sparse and vertical form and displays yellow, daisy-like flowers (USDA).

Bothriochloa barbinodis, Herter Cane Bluestem, **NH, RTA**

This native grass is a wispy bluish low-lying grass (USDA).

Bouteloua artistidoides, Needle Grama, **NH, RTA**

This native grass is very long and fine (USDA).

Brassica species (unidentifiable)

Plants in the genus *Brassica* are often utilized as a food and seasoning source and are commonly grown as mustard seed crop. They are thought to originate from Europe and Asia (Wink 2008). Some species are sometimes called "Black Mustards" and can be poisonous. These "black" species sequester dangerous amounts of nitrate and may produce goiter and anemia in those ingesting their seeds and roots which contain the highest doses of the toxin (Schmutz 1979).

Bromus catharticus, Rescue Grass, **EH, T-1909, ARIZ 196700**

This grass which grows 2 to 3 feet high is sometimes grown for foraging and is a native of South America (Bailey 1949).

Calibrachoa parviflora, D'Arcy Seaside Petunia, **NH, T-1909, RTA**

This native herb produces thin, branching stems which grow along the ground rooting as they go. The vertical branches are leafy and their showy purple flowers are large and colorful giving the plant the appearance of an ornamental (USDA).

Chenopodium sp., Goosefoots, **ARIZ 62604***

The big green leaves of some species of plants in the *Chenopodium* genus are often edible as leafy stock however other species in the genus can be poisonous (USDA).

Chenopodium murale, Nettle Leaf Goose Foot, **EH, :X:, T-1909**

This poisonous plant contains oxalic acid, oxalates, other organic acids and cytotoxins which are moderately to highly hazardous. Symptoms of ingestion include, necrosis, inflammation of the eyes, burning mouth and throat, gastrointestinal disorder, and spasms (Wink 2008).

Conium maculatum, Poison Hemlock, **EH, :X:, ARIZ 165857*, 62885***

This is perhaps the most poisonous and deadly plant in the area. Also called spotted hemlock, or poison parsley, *Conium maculatum* is a forb of the parsley or carrot family. The plant was introduced from Eurasia and is frequently found in meadows, along roads and in drainage-ways throughout the U.S. and southern Canada (Schmutz 1979). This plant, growing to 9 ft. tall, is one of the most poisonous plants of the world (Foxy 1985). All parts of the plant are poisonous. Like the mustard, it contains the highest levels of toxic and deadly compounds in its seeds and roots. Poison Hemlock was commonly used by Greeks and Romans in murders and suicides. It was used to execute Socrates in 399 BC for teaching of Greek gods in a blasphemous way (Wink 2008). Symptoms of *Conium maculatum* ingestion are burning of the mouth and mucus membranes, nervousness, trembling, loss of coordination, dilation of the pupils, general weakness, coldness, convulsions, coma, and death due to respiratory paralysis. As little as 2-4 kg of dried leaves can kill a grown cow if ingested (Schmutz 1979).



Conium maculatum

Conyza canadensis, Horseweed, **NH, T-1909, RTA**

Also known as Canadian horseweed, Canadian fleabane, coltstail, marestail, and butterweed, this plant is generally considered a weedy species. It is unique however in its extremely thin, vertical, and dense form (USDA).

Cryptantha angustifolia, Narrow Leafed Forget-Me-Not, **NH**

This fatter leafed *Cryptantha* has white flowers and like others of this genus, it is covered in stiff hairs which lay flat along its body. It is a good food source for harvester ants (Leake 1993).

Cynodon dactylon, Bermuda Grass, **EH, P, T-1909**

Bermuda grass is a predominant exotic grass species along the

Santa Cruz. It is perhaps one of the most predominant and problematic invasive exotic species in the Southwest next to buffelgrass. It was introduced as a hardy grass in the early 1900's and has been problematic ever since, finding its way to most disturbed and urban areas. Once your yard is infested its absolute removal is next to impossible without the regular treatment of herbicides to the infected areas. It is also a cyanogenic glucoside producer and can cause gastrointestinal problems in forging livestock (Wink 2008).

Cyperus sp., **CLP, ARIZ 63237 ***

The *Cyperus* genus is comprised of around 600 sedge plants, most of which are aquatic and exotic however some natives do exist. These plants have a unique form and can often be found as ornamentals in local aquatic gardens and ponds (USDA).

Dactyloctenium radulans, **Buttongrass, EH, ARIZ 187719**

This is a native grass species (USDA).

Datura meteloides, **Sacred Datura, NH, :X:, T-1909, RTA, OIU**

Also called Indian-apple, Tolguaca, Jimson weed and moonflower, this plant is in the nightshade family and is easily identifiable by its round, golf ball sized, spiked, green seed pods and large tissue paper-like silky flowers. The plant has been used by native peoples for centuries in the prevention of miscarriages and as a link to the spirit world. The plant contains hallucinogenic toxins (Schmutz 1979). The Aztecs are one people which used the plant for this purpose as well as medicinally to treat multiple ailments (Wink 2008). Some native healers believe its leaves can be heated and placed on bruises, sprains, and broken bones in order to ease pain and aide in the healing process (Yetman 2009). Many people have unwittingly taken it upon themselves to experiment with this plants hallucinogenic properties and have temporarily lost their sanity, experiencing bouts of visual and auditory hallucinations for periods lasting 12 to 24 hours. Ingesting as little as half the contents of one seed pod can bring about these psychotic effects. Ingestion can also lead to death. Interestingly it derives one of its common names, Jimson weed, as a corruption of Jamestowne where in 1676 soldiers ate the plant and suffered terribly (Foxy 1985).

Descurainia pinnata subsp. *ochroleuca*, **Detling Western Tansymustard, NH, T-1909, ARIZ 1938**

This small native herb has a vertical form terminating in a yellow cluster of flowers (USDA).

Echinochloa colonum, **Jungle Rice, EH, T-1909**

This exotic wild grass from Asia is often used as a famine food source. Its seeds are mashed and made into a flour for bread or porridge (USDA).

Eichhonia crassipes, **Water Hyacinth, EH, OT**

Commonly known as water hyacinth, this plant is a floating, aggressive, invading species which can quickly overcome a standing water source and choke out its oxygen dependent aquatic life by smothering the aquatic system. I came across it only once at one specific location a few years after completing my initial thesis work and was amazed by its sheer numbers. It had completely over-taken the surface of a large standing effluent pond just upstream of the Ina road outlet. The plant has been frequently used as a pond plant, however its use has been outlawed due to its voracious and dominating nature over riparian areas.

Eriochloa aristata, **Bearded Cupgrass, NH, T-1909, ARIZ 165866**

This grassy plant is an annual to Arizona, California and northern Mexico, (Kearney 1951).

Gaura parviflora, **Velvet Weed, NH, RTA**

Also known as velvety guara, downy guara, and smallflower guara, this plant grows to 6 ft. with lance shaped leaves, pink flowers, rose colored stamens, and red anthers, (Foxy 1985).

Gnaphalium wrightii, **Cud Weed, NH, RTA**

Also known as everlasting, this is a weedy native plant. Based on its common name one might assume it plays a role in the feeding of livestock (USDA).

Hedypnois cretica, **Creteweeder, EH, ARIZ 30508**

Also known as Cretanweed, this plant is native to the Mediterranean basin and is a noxious weed in the Southwest (USDA).

Heterotheca subaxillaris, **Camphor Weed, NH, RTA**

Also known as telegraph plant and golden aster, this native herb has a delicate form with yellow daisy-like flowers. Leaves of the plant wreek of camphor and will leave a pungent oil on your hands or clothing (USDA).

Hydrocotyle ranunculoides, **Water Pennywort, NH, T-1909, RTA**

Known as floating pennywort, this aquatic is native to the Americas but an invasive exotic in the United Kingdom (USDA).

Lappula redowskii, **Stickseed, NH, RTA, ARIZ, 300428, 193846**

This small herbaceous plant grows across Arizona from 1,000 to 8,500 feet in areas with ample sun and disturbed soils (Kearney 1951).

Lathyrus oderatus, **California Common Sweet Pea, EH, ARIZ 208816**

This herbaceous and showy flowering annual is a native to the Mediterranean (Munz 1974).

Lepidium oblongum, **EH, ARIZ 193855**

This is a delicate and uniquely shaped low lying native (USDA).

Lepidium virginicum, **Virginia Pepper Weed, EH, ARIZ 193856**

This herbaceous plant with clustering yellow flowers was listed by Munz as a US native but Arizonan exotic. It is commonly found in disturbed areas (Munz 1974).

Linaria canadensis, *L. texana*, **Toad Flax, EH, ARIZ 193848**

Also known as blue toad flax, this California native is often found on scorched landscapes (Munz 1974, Calflora).

Ludwigia palustris, **Marsh Purslane, NH, RTA**

This native aquatic plant can be found intermitantly along the effluent dominated stretch of the Santa Cruz. It is unique in its delicate form and ornamental flower structure. It represents one of a number of delicate and showy aquatic stream edge groundcovers which can be found in the area (USDA).



Ludwigia palustris

Malva neglecta, Mallow, **EH**

Also known as cheeseweed, *Malva neglecta* has white to blue flowers and grows low to bushy. This annual growing to 1 ft. tall has fruits which resemble a small round of cheese. These fruits are edible when young, (Foxy 1985).

Matthiola longipetala, Night-Scented Stock, **EH, ARIZ 128339, 128340**

Also known as the evening stock, this plant, a native from Eurasia, is grown for its showy purple flower clusters whose fragrant scent permeates its surroundings during the evening hours (USDA).

Melilotus indicus, Sour Clover, **EH, :X:, T-1909, ARIZ 66797***

This plant contains anticoagulating compounds which are sometimes used medicinally. They are also harmful if taken improperly and cause internal bleeding. The plant can cause sudden death in cattle (Wink 2008).

Melilotus species (unidentifiable) Sweet Clover, **EH, :X:**

Plants in the genus *Melilotus* are also called melilots. They are native to Europe and Asia, emit a pleasurable fragrance, and contain coumarin, a common perfume additive (USDA).

Mimulus floribundus, Manyflowered Monkeyflower, **NH, RTA, ARIZ 42232**

This small native riparian herb is a low lying plant with alternating leaves and showy yellow flowers (USDA).

Mimulus guttatus, Monkey Flower, **NH, P, RTA, SpecSig, IFS**

The stems and leaves of this edible plant can be used as greens in salads (Leake 1993). This plant was found in just under 30% of transects. When it occurred it numbered from 20 – 30 individuals. This plant served as a common food plant of indigenous peoples (Foxy 1985).

Spec Sig: According to Phil Jenkins, Monkeyflower indicates water being present, even surface ephemeral water after rains.

Monolepis nuttalliana, **NH, T-1909, ARIZ 19385**

This plant occurs frequently in southern Arizona at elevations of 3000 ft. and lower. Native peoples made pinole from its seeds and it has served as a fairly strong pasture food for cattle (Kearney 1951).

Muhlenbergia microsperma, Littleseed Muhly, **NH, ARIZ 106414**

This native grass has a delicate clumping form (USDA).

Nama hispidum, Grey Bristly Nama, **NH, T-1909, RTA, ARIZ 43359**

This low lying herbaceous forb has showy purple flowers and delicate green stems.

Nasturtium officinale, Water Cress, **EH, T-1909, SpecSig, ARIZ 193847**

Formerly known as *Rorippa nasturtium-aquaticum*, this plant grows submersed and above calm waters with a dense and low-lying spread of green foliage and white flowers. Its terminal leaves are larger than its laterals and they have a mild pepper taste. They have been used around the world as greens and as a seasoning in soups. The plant is naturalized from Europe (Foxy 1985).

Spec Sig: According to Phil Jenkins, watercress is a plant that is dependant on permanent water, with at least some parts of the plants submerged.



Nasturtium officinale

Nicotiana trigonophylla or *N. obtusifolia*, Desert Tobacco, **NH, :X:, T-1909, RTA, ARIZ 43739***

Also called coyote tobacco, this Sonoran Desert native riparian plant was used for smoking by the Yuma and Havasupai tribes.

Desert tobacco's scientific name was coined by a sixteenth-century French ambassador to Portugal, Jean Nicot, who introduced the plant in France (Leake 1993).

Panicum stramineum, **NH, T-1909, RTA, ARIZ 16588**

This is a mid-sized native grass.

Parietaria hespera, Pellitory, **EH, ARIZ 193845**

Also known as pellitory, Rillita pellitory, and western pellitory, this annual herb is a native of California (Calflora).

Petunia parviflora or *Calibrachoa parviflora*, Wild Petunia, **NH, RTA, ARIZ 193858, 62081**

This California native annual herb can be found in sandy riparian habitat (Calflora).

Phalaris minor, Littleseed Canary Grass, **EH, :X:**

This is a medium sized grass with large clumping fruits (USDA). It is commonly observed in patches in the study area.

Polanisia doderandra, Clammy Weed, **NH, RTA**

Also known as redwhisker clammyweed, this plant is an annual native of much of the United States (USDA).

***Polygonum argyrocoleon*, EH, ARIZ 117341**

This herbaceous annual is a native of Asia (Munz 1974).

***Polygonum aviculare* L., EH, T-1909, ARIZ 193853**

This herbaceous plant is frequently dispersed throughout North America and is naturalized from Eurasia (Kearny 1951).

***Polygonum lapathifolium*, Curly Top Knotweed, EH, P, T-1909, RTA, ARIZ 165888, 68400** This herbaceous plant is frequently dispersed throughout North America and is native to many parts of North America but not Arizona (Calflora, Munz 1974). It is commonly found in the study area occurring in large patches.



Polygonum lapathifolium

***Polygonum pensylvanicum*, Lady's Thumb, NH, RTA**

Also called knotweed and smartweed, these plants contain slightly hazardous anthraquinones and naphthodianthrones which are cell toxic and mutagenic, (Wink 2008).

***Polygonum* species (unidentifiable) Knotweed, NH, RTA**

Also often called smartweed, knotgrass, bistort, tear-thumb, and mile-a-minute, plants of the polygonum are unique in that they often have reddish or reddish speckled stems and clustering flowers of pink, white, or green (USDA).

***Ranunculus sceleratus* var. *multifidus*, Cursed Buttercup, NH, RTA, ARIZ 193843**

This native herb is a very light green in color with big yellow flowers (USDA).

***Rumex crispus* or *R. hymenosepalus*, Curly-Leaf Dock., NH, P, :X:, RTA**

Rumex crispus grows to 3 ft. tall with lanced to oblong leaves, large with many margins. It has yellow flowers and triangular shaped fruit (Foxx 1985). All parts of the *Rumex crispus* are poisonous containing tannins, physcion, aloe-emodin (anthroquinones), and high levels of oxalates. These secondary compounds can cause gastro-intestinal tract disorder, nausea, vomiting, and abdominal pain. Poisonings usually occur in animals (Wink 2008).

***Rumex dentatus* L., Toothed Dock, EH**

This native of Eurasia and Africa can be found growing in disturbed moist areas. It is an allelopathic plant producing compounds which prohibit the growth of other plants in its vicinity (USDA).

***Salsola kalivar*, Russian Thistle, EH**

Also known as white man's plant, the *Salsola kalivar* has branched, reddish stems growing to 6 ft. It is a Russian annual native whose seeds were brought to the U.S. in flax seed. It is a very prolific weed, (Foxx 1985).

***Sinapsis arvensis* or *Brassica arvensis*, Wild Mustard, EH**

Also known as charlock, this European native has become a common exotic weed in much of North America. This plant is highly invasive and is poisonous to livestock (USDA).

***Sisymbrium orientale*, Indian Hedgemustard, EH**

Also known as Oriental hedgemustard, this non-native plant has naturalized itself into many regions across the United States West and Southwest (USDA).

***Sisymbrium irio*, London Rocket, EH**

This invasive species from Europe thrives in the desert wherever there is high amounts of water. The plant grows in winter and spring and dies back during hot months. The tips of this plant are topped with small yellow flowers, (Leake 1993).

Solanum nigrum* or *S. americanum*, Nightshade, NH, :X:, IFS, RTA, ARIZ 80797

Known as black nightshade, common nightshade, and poisonberry, its leaves and un-ripe berries contain high concentrations of the glycol-alkaloid, solanine which is extremely toxic. When ripe and boiled however, the berries may be used to make pies and jellies. Symptoms of solanine ingestion include headache, vomiting, diarrhea, dilated pupils, shock, and paralysis (Schmutz 1979).

***Solanum rostratum*, Buffalo Bur, NH, RTA, ARIZ 69834**

Also known as spiny nightshade and Texas thistle, this native weedy plant of the Nightshade family has a unique flower which exhibits the rare trait of heteranthery, meaning it has two distinct anthers of different size (USDA).

***Sonchus oleraceus*, Common Sow Thistle., EH**

This exotic species also known as sow thistle, smooth sow this-

tle, annual sow thistle, hare's colwort, hare's thistle, milky tassel, and swinies, is a medicinal and food plant from Europe and Asia (USDA).

Sorghum halepense, Johnson Grass., **EH, T-1909**

This invasive mid-large sized grass can be found throughout much of the United States and parts of Canada (USDA).

Suaeda moquinnii, Seep Weed., **NH, T-1909**

This native to California is also known as the inkweed, Mojave seablite, bush seepweed, quelite, and salado. It favors salty areas along the coast of California (California).

Teucrium cubense, Small Coastal Germander., **NH, T-1909, RTA**

This desert native is commonly found in wetland communities in the southern United States (USDA, California).

Veronica anagallis-aquatica, Speedwell, **P, NH, RTA, SpecSig, :X:, ARIZ 73825***

This is a predominant low lying stream edge plant which has ornamental purple flowers (USDA). It can be found along most of the study area.

Spec Sig: According to Phil Jenkins, like watercress, this plant is partly submerged, and is therefore an indicator of permanent water. It frequents slow flowing streams.



Veronica anagallis-aquatica

Veronica perigrina L. *xalapensis*, Neckweed, **EH, ARIZ 193860**

This simple annual is often found in areas which have suffered fire damage and is commonly found below 9000 feet in Arizona (Munz 1974, Kearny 1951).

Veronica species (unidentifiable)

The genus *Veronica* contains over 500 flowering species and are often food sources to various butterfly species (USDA).

Xanthium strumarium, Cocklebur., **NH, :X:, P, T-1909, RTA**

Known as cocklebur, it is a native plant which is naturalized all over the world (Wink 2008). It is commonly found along most of the study area. The plant is deadly poisonous and can be a cause of sudden death in livestock and other grazing animals. Animals die 10 to 15 minutes after ingestion of this plant and others like it in the cyanogenic plants category. In comparison, *Conium maculatum* or poison hemlock, can take up to one hour to cause death after

ingestion (Burrows 1989). Cyanogenic plants are those containing cyanogenic glucosides. These glucosides are present in more than 2500 plant species comprising the cyanogenic plant group. These secondary compounds are an evolutionary defense mechanism by which these plants protect themselves from herbivory. Upon plant tissue damage, hydrogen cyanide is released killing or deterring the herbivores. Three people died in China after they mis-identified the buds from this plant as food (Wink 2008).



Xanthium strumarium

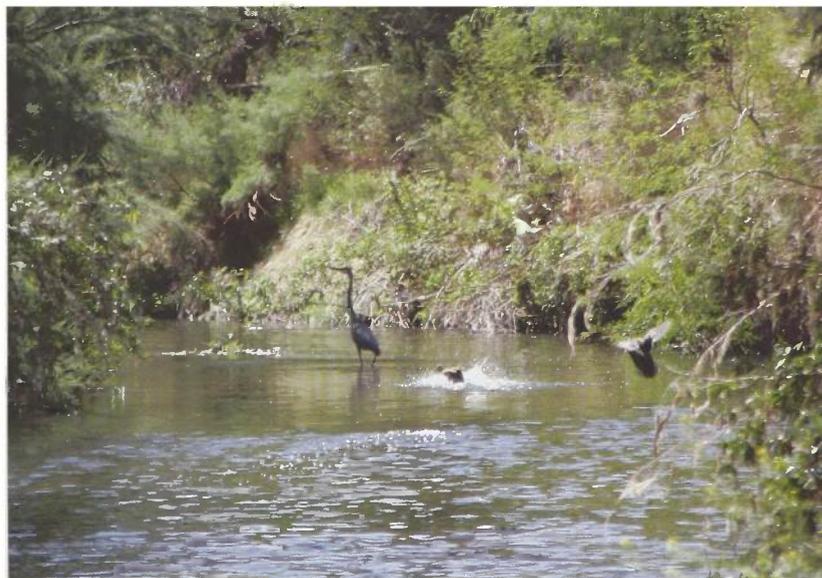
All photographs were taken by the author.

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Great blue heron and other water fowl



Svalbard morning (M. Norem)