



## Vegetation Protocol & CAP LTER

Many of the questions CAP LTER vegetation researchers are interested in are centered around the human influence on plants. How do people choose the plants for their landscapes, how do they take care of them, and what effect does all this have on plant growth? In combination with other monitoring efforts questions are asked about how plant diversity and plant growth affect other populations in the city such as birds and bugs.

At CAP LTER we distinguish between long-term monitoring, one time observations and manipulative experiments. All of which are applied to vegetation research. We monitor changes in vegetation structure at 200 sites randomly located throughout the city and surrounding desert and agricultural lands every five years (2000, 2005, 2010, etc.). In this project, the Survey 200, size and exact location of every plant in a 900 square meter plot is recorded. At a subset of these sites a more intensive monitoring of plant growth takes place. One time observations have been used to re-survey plant communities in desert remnants that were described 20 year earlier. Concentrations of elements in leaves and lichens have been measured throughout the area to document distribution of air pollutants. In manipulative experiments the effect of different landscape practices on plant performance is being tested. Popular landscaping plants are treated with different amounts of irrigation, different ways of pruning and different mulching materials. All of which influences the growth and the water needs of these plants. Your schoolyards will another site that can be used for long-term monitoring or even manipulative experiments.

Information about your schoolyard vegetation can be used in conjunction with other Ecology Explorer protocols. For example the type of vegetation may influence the kinds of arthropods students find in the arthropod survey protocol. Schools which are installing a native habitat in their schoolyard should keep careful measurements of the vegetation. CAP LTER scientists also encourage you to do vegetation surveys in vacant lots, parks and golf courses.

### Comments on the Protocol:

The method for surveying plants in a schoolyard is different than using a transect method to survey plants in a desert remnant. The methods described for measuring plant attributes are similar to those used by CAP LTER scientists conducting our Survey 200.

### Grade Level:

Identifying plant types can be done with the early grades, identifying them to species requires reading and sorting skills. Measuring circumferences and areas can also be done by all grades, but calculations of tree height and areas need students with higher math skills (>4th).



## web page content

### Phoenix Vegetation

#### Adapted to desert living

Over the past 100 years, people have removed a lot of native vegetation and planted non-native plants, trees, and shrubs. However, some desert remnants remain within the Phoenix metropolitan areas, for example, Papago Park near the Phoenix Zoo and Desert Botanical Garden.

CAP LTER scientists are conducting plant surveys across the Phoenix metropolitan area. They will be comparing the survey results to studies done 20 years ago. They also are interested in comparing vegetation in desert remnants to that in residential areas, parks, golf courses and vacant lots.

#### You can help preserve our natural environment

You can participate in this study by comparing schoolyard and/or backyard data to desert remnant data and sharing this information with CAP LTER scientists. You may also decide to correlate your vegetation studies with the Ecology Explorers' bird and insect studies.



## web page content

### Vegetation Study

#### Why study vegetation?

- ◆ Plants form the basic foundation of food webs and support other life forms.
- ◆ Native plants have unique adaptations for living in desert environments.
- ◆ Non-native plants have different requirements (soil, water, nutrients) than native plants.
- ◆ The vegetation can influence the kinds of animals that are attracted to the area.
- ◆ Vegetation can be a sensitive indicator of change in local or regional environments.

#### What vegetation should we study?

The items most commonly found in a schoolyard include grass, trees, shrubs, cacti, and ground cover.

#### What does vegetation tell us about the urban environment?

Vegetation tells us about other environmental factors such as nutrient or water availability. Differences between residential areas and desert remnants tell us about human behavior and decisions to alter the landscape. Identifying non-native vegetation contributes to understanding similarities and differences between animal populations in desert remnants and residential areas. There may be many factors that help to explain why certain types of vegetation are planted in particular areas. Not all residential areas are alike, so it is also worthwhile to compare differences among schoolyards and/or backyards.

#### What materials will you need?

- Map of Your School
- Pencil
- Data Sheet
- Protractor
- Ruler
- Metric Tape Measure
- Metric Measuring Wheel (optional)



## web page content

### Vegetation Protocol

#### How to survey schoolyard vegetation

#### Measure (see methods below) and identify (see identification keys)

- a). Size of yard: measure perimeter, use geometry to calculate area.
- b). Estimate percentage of landcover in your study area. Record your findings in the habitat description data sheet. You will need to do this before entering data into the CAP LTER database. **YOU ONLY NEED TO DO THIS ONCE PER AREA OF STUDY.**
- c). Record the number, identity and size of trees:
  1. count trees, give ID numbers to the trees you will be measuring
  2. identify species (mesquite) or category (palm)
  3. measure circumference at breast height (CBH)
  4. estimate height
  5. estimate size of canopy
- d). Record the number, identity and size of cacti
  1. count cacti, give ID numbers to the cacti you will be measuring
  2. identify species
  3. measure CBH for tall cacti and area covered for smaller cacti
  4. measure height: for small cactus use a tape measure, for large cactus estimate following procedure for trees
- e). Record the number and size of shrubs:
  1. count shrubs, give ID numbers to shrubs you will be measuring
  2. identify species
  3. use tape measure to measure height and canopy



## web page content

### Methods (website contains illustrations)

a & b: To measure area:

use either a long tape measure or a measuring wheel to measure the length and width to get the area

c3 and d3: To measure the circumference of trees and tall cacti:

Use a tape measure and wrap around the trunk of the tree. Measure at the same height for each tree/cacti. Typically this height is about 1.35m from the ground (if your students are short, than use a lower height, but make sure it is the same for all measurements)

c4 and d4: To estimate the height of trees and tall cacti:

**Method 1:** Attach a plumbline at right angles to an isosceles right triangle made of cardboard.

Move until you can sight the top of the tree along the sloping edge of the triangle. Keep the upright edge vertical using plumbline. Measure the distance from the tree. Add your eye height to give you the tree's height.

**Method 2:** Measure your shadow. Measure the tree's shadow (make your shadow measurement during the same time of day). Calculate the tree's height using the following:

$$\frac{\text{Height of tree}}{\text{Tree's shadow}} = \frac{\text{Your height}}{\text{Your shadow}}$$

Alternatively, you can place a meter stick upright and measure it's shadow in place of measuring the student's shadow.



## web page content

c5: To estimate the size of the tree canopy:

**Method 1:** Measure the perimeter of the canopy and use geometry to calculate area.

**Method 2:** Measure the diameter of the canopy, assume it is a circle and calculate the area.

*Formulas for Geometric Shapes:*

Area of a square or rectangle = length x width

Area of a circle =  $\pi r^2$  (r = radius,  $\pi = 3.14$ )

Area of a triangle =  $1/2$  base x height



## Estimating the Percentage of Landcover in Your Schoolyard:

We are really interested in your schoolyard's habitat structure. For any of the Ecology Explorers protocols we ask that you do a "Habitat Description" that divides the plants in your study site into three layers. The layers are divided into 1) ground level (<.15 m), 2)shrub level (.15m – 1.5 m), and 3) tree level (>1.5 m). Ground level is further subdivided into concrete/gravel, buildings, and plants.

*Here are two ways to estimate the percentage of each type of plant cover in your plot.*

**A.** Calculate the percentage of each type of cover by dividing it by the total surface area of the plot and multiplying by 100. For example if you found the total surface area of the lawn in a 10m<sup>2</sup> plot is 5 m<sup>2</sup> than 5 m<sup>2</sup>/10m<sup>2</sup> times 100 would give you 50% of the surface area is covered by lawn. If there are various land cover types that are irregularly shaped, estimate their size by measuring them as rectangles, squares, etc.

**B.** Line transect/intercept method: this method consists of taking observations on a line or lines laid out randomly or systematically over the study area.

- a. Determine how long each transect line will be. In many ecological studies the length is either 50 m or 100 m. This may be too long for your study site so you can use a shorter length.
- b. Subdivide the transect line into predetermined intervals such as 1 m.
- c. Move along the line, and at each interval record the plants at each height interval (i.e. <.15m, 0.15-1.5 m, >1.5) and the distance they cover along that portion of the line intercept. Consider only those plants touched by the line or lying under or over the line.
  - i. For grasses, rosettes, herbs, measure the distance along the line at ground level
  - ii. For shrubs and trees, measure the distance covered by a downward projection of the foliage above.
  - iii. For concrete, gravel, etc. measure the distance along the line at ground level.

You need to do several transect lines in the area and then combine the results. The number of lines you do depends on the size of the plot. For small plots 5- 10 lines may be sufficient, for larger plots you may wish to do 20 to 30 lines.

You can figure out the percentage of each type of cover by:

(Total intercept length vegetation type A/Total transect length) X 100 = % cover

For example if you did 5, 20m-transect lines and you found that shrubs (0.15 m-1.5 m) intercepted the line for a total of 15m then:

$$\left( \frac{15}{5 \times 20} \right) \times 100 = 15\%$$



## Method A

### Data Sheet for Estimating the Percentage of Landcover in Your Schoolyard

Total Surface Areas Surveyed \_\_\_\_\_ (m<sup>2</sup>)

	Area Covered (m <sup>2</sup> )	$\frac{\text{Area Covered}}{\text{Total Area Surveyed}}$	Percentage
<b>&lt;0.15 m</b>			
Lawn			
Other Vegetation			
Gravel/Soil			
Pavement/Building			
<b>0.15-1.5 m</b>			
<b>&gt;1.5 m</b>			





## Method B

### Data Table for Estimating the Percentages of Landcover in Your Schoolyard

Point	0 - 0.15 m				0.15m – 1.5m	>1.5m
	Lawn	Gravel	Pavement or Building	Other Vegetation	Shrubs	Tree Canopy
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

**TOTALS::**  $\frac{\text{Total length along transect line}}{\text{Total length of transect line}} \times 100 = \% \text{ coverage}$

Lawn \_\_\_\_\_ x 100 = \_\_\_\_\_ %  
 \_\_\_\_\_ %

Other Vegetation \_\_\_\_\_ x 100 = \_\_\_\_\_ %

Gravel/Soil \_\_\_\_\_ x 100 = \_\_\_\_\_ %

Pavement/Building \_\_\_\_\_ x 100 = \_\_\_\_\_ %



## Data Sheet for Multiple Line Transect/Intercepts

	Length along transect 1	Length along transect 2	Length along transect 3	Length along transect 4	Length along transect 5	Total
<0.15 m						
Lawn						
Other Vegetation						
Gravel/Soil						
Pavement/ Building						
0.15-1.5 m						
>1.5 m						



## Site and Habitat Description

### Protocol: Vegetation

Provide a site and habitat description of your research site. For example, if you are collecting data at seven locations on your campus, you will enter seven different sites. The description includes the amount and type of vegetation (or non-vegetation) at different heights in your research.

#### SITE DESCRIPTION

Teacher: \_\_\_\_\_ Class: \_\_\_\_\_

School: \_\_\_\_\_

Street Address: \_\_\_\_\_

City: \_\_\_\_\_ Zip code: \_\_\_\_\_

Site Name: \_\_\_\_\_

Create a name to identify the research site for which you are collecting data. (e.g. Playground South Corner)

Site ID: \_\_\_\_\_

Create a 3 – 5 letter and/or number code to identify this site. (e.g. Playground South Corner – PGSC)

**Site Location** Write a brief description of where your site is located. (i.e. SW Corner of playground): \_\_\_\_\_

**Description** Write a description of your site so that a visitor to your school would be able to find your research site: \_\_\_\_\_

#### HABITAT DESCRIPTION

Recording Date: \_\_\_\_\_

Radius (m): \_\_\_\_\_

Vegetation >1.5 m	_____ % Tree Canopy
Vegetation 0.15m—1.5 m	_____ % Shrub
Vegetation and non-Vegetation <1.5m (should be equal to 100%)	_____ % Gravel or soil
	_____ % Lawn
	_____ % Paved or Building
	_____ % Other Vegetation



## Vegetation Data Sheet

Teacher: \_\_\_\_\_  
 Class: \_\_\_\_\_  
 Site ID: \_\_\_\_\_ Collection Date: \_\_\_\_\_  
 Observers Name: \_\_\_\_\_

### Vegetation Count

Type of Vegetation	Count	Type of Vegetation	Count	Type of Vegetation	Count
Trees		Shrubs		Cactus	

### Survey Data

Type of Vegetation (Tree, Cactus or	I.D. No. (Create an ID #)	Species Name	CBH (m)	Height (m)	Canopy Size or area covered (m <sup>2</sup> )	Comments/ Location



## Vegetation Keys

We've put together two types of descriptive vegetation keys. The first is a key for plants found in the Sonoran desert and the second is a key for common ornamental plants found in landscaping. Links to herbarium samples can be found on the website.

## Sonoran Desert Plants: Cactus

### Prickly Pear Cactus (stems flat and broad)

*Opuntia basilaris* (Beavertail cactus). Plants without spines.

*Opuntia chlorotica* (Pancake prickly pear). All of the long spines on the flat surface of the stems point downward. Most stems are more round than oblong. Spines 2-4 cm long.

*Opuntia engelmanni* (Engelmann's prickly pear). Joints can be more than 25 cm long. Joints more oblong than round. Spines 2-4 cm long. Usually does not grow close to ground. Spines equally distributed between top and bottom halves of joints

*Opuntia pheacantha* (Brown-spined prickly pear or Sprawling prickly pear.). Joints 15-25 cm long. Spines 5-6 cm long. Most of longer spines are on top half of joints. Grows close to ground.

### Saguaro Cactus

*Carnegiea gigantea*. Vertical ribs. Stem is much taller than wide (at least 10 times). Very massive. One main trunk with the possibility of several branches high up on the trunk.

### Hedgehog Cactus

*Echinocereus engelmanni*. Vertical ribs. Plant small, usually less than 0.5m high. Stems single jointed. Grows vertically. Plant looks very spiny.

### Barrel Cactus (Large plant (0.5-3 m. high). Can be almost as wide as tall. Barrel shaped.)

*Ferocactus acanthodes* (compass barrel cactus). None of the spines are hooked.

*Ferocactus wislizeni* (Fishhook barrel cactus). Some of the spines are hooked.

### Cholla cactus (cylindrical stems, many branches)

*Opuntia acanthocarpa* (buckhorn cholla). End joints 2 cm. or more in diameter. Joints do not fall off and there are no joints scattered under plants.

*Opuntia arbuscula* (Pencil cholla). End joints 7-10 mm. in diameter

*Opuntia bigelovii* (teddy bear cholla) Fruits do not grow in chains. End joints short and very easily dislodged. May be joints scattered around underneath plant. Can be up to 6 feet tall (~1.8m).

*Opuntia fulgida* (chain fruit cholla) Fruits grow in chains. End joints longer and may be dislodged, but not as easily as teddy bear cholla. Can be up to 12 feet tall (~3.6m).

*Opuntia leptocaulis* (desert Christmas cactus). End joints 3-5 mm in diameter and 2.5-7.5 mm long. Plant less than 1 m high. May have red fruit.



## Pincushion Cactus

*Mammillaria microcarpa* (Arizona fishhook cactus). Vertical ribs. Small round cactus. Spines are hooked (like a fishhook).

## Ocotillo (Not actually a cactus but may be confused as one, actually a shrub)

*Fouquieria splendens*. Up to 6 m tall, vertical branches joining at ground, many spines along branches. Leaves green, oval, up to 5 cm long. Most of the year the branches are leafless.

## Sonoran Desert Plants: Trees

*Acacia greggii* (cat-claw acacia). Spines very curved

*Olneya tesota* (ironwood) Medium sized tree, up to 9 m. tall. Trunk up to 45 cm in diameter, leaflets and bark grayish. Bark may be stringy. Spines not yellow and may be slightly curved.

### Palo Verde (greenish trunks)

*Parkinsonia florida* (blue palo verde). Bark/branches blue-green. Leaflets 4-8 cm long, usually 3 or less pairs of leaflets per stem.

*Parkinsonia mycophylla* (foothills palo verde). Bark/branches yellow-green. Leaflets very tiny (3 mm. long or less), usually 4 to 8 pairs of leaflets per stem.

*Parkinsonia aculeata* (Mexican palo verde). Bark and/or young branches yellow/green. Main leaf stems flattened and 10 cm long or longer. Leaflets alternate. Spines in clusters of 3.

*Prosopis velutina* (velvet mesquite). Small tree, up to 3 m tall, leaflets and bark not grey. Spines yellowish, not curved. Bark not stringy. Branches grow in a zig-zag pattern.

## Sonoran Desert Plants: Shrubs

### I. Characteristic

- |  |            |
|--|------------|
| Leaves absent or obscure.                              | Go to II.  |
| Leaves linear, sides parallel (like a blade of grass). | Go to III. |
| Leaves triangular (deltoid).                           | Go to IV.  |
| Everything else.                                       | Go to V.   |

### II.

*Ephedra sp.*: 3-4 ft tall. Scale-like leaves, when present. Stems are yellow-green and jointed.

*Fouquieria splendens* (Ocotillo): Leaves green, oval, up to 5 cm long. Leafless most of year. Many spines on stems.

*Krameria grayi* (white ratany): Up to 2 ft. tall. Leaves gray, finely hairy, narrow, up to 1/2 in. long.



### III.

Leaves hairy. Go to A

Leaves not hairy. Go to B

#### A

*Hymenoclea salsola* (burro brush, cheeseweed): Leaves dark green, very slender, lower leaves have 3 or more threadlike divisions, up to 7.6 cm, long. Foliage has cheesy odor when crushed.

#### B

*Atriplex canescens* (four-wing saltbush): Up to 2.5m but mostly 1.2 m. Leaves gray-green, narrow, up to 5 cm long.

*Baccharis salicifolia* (seep willow): Up to 3.5 m high. Leaves dark green, shiny, waxy, sticky, lance-shaped, toothed, up to 15 cm long and 12 mm wide.

*Baccharis sarothroides* (desert broom): Up to 3 m tall. Leaves bright green, smooth, sticky, up to 4 cm long and 3 mm wide. Growth resembles a broom.

*Bebbia juncea* (chuckwalla's delight): Up to 1.2 m tall. Leaves (when present) dark green, sparse, linear to lance shaped, lobed, rough, hairy, up to 5 cm long.

*Gutierrezia sarothrae* (broom snakeweed): Up to 1.2 m tall. Leaves dark green, very narrow, up to 3 mm wide and 6.4 cm long.

### IV.

*Ambrosia deltoidea* (triangle bursage): Up to 1.2 m tall. Leaves gray-green above, white and hairy underneath, finely toothed, up to 3 cm long.

*Viguiera deltoidea* (parish viguiera): Up to 1.2 m tall. Leaves dark green, hairy, toothed, crinkled, up to 4 cm long. Grayish bark.

### V.

Leaves serrate (toothed) or divided/compound AND hairy. Go to A

Leaves serrate (toothed) or divided/compound and NOT hairy. Go to B

Leaves simple and entire (not toothed) AND hairy. Go to C

Leaves simple and entire (not toothed) and NOT hairy. Go to D

#### A

*Ambrosia ambrosoides* (canyon ragweed): Up to 1 m tall. Leaves green, hairy, elongated to lance shaped, toothed, up to 13 cm long and 2.5 cm wide.

*Hibiscus denudatus* (rock hibiscus): Up to 1 m long. Leaves yellow-green, densely hairy, oval to elliptical shaped, toothed, and up to 3 cm long.

*Hyptis emori* (desert lavender): Up to 4.5 m tall. Leaves gray-green, oval shaped, hairy, toothed, up to 6 cm long.



## B

*Celtis pallida* (Desert Hackberry): Up to 6 m tall. Leaves dark green, elliptical to oval, toothed or untoothed, up to 4 cm long and 19 mm wide.

*Trixis californica* (trixis): Up to 1 m tall. Leaves dark green, lance shaped, smooth edge or toothed, up to 5 cm long and 12 mm wide.

## C

*Encelia farinosa* (brittlebush): Up to 1.2 m tall. Leaves greenish gray and hairy, oblong or triangular shaped up to 10 cm long.

## D

*Atriplex polycarpa* (little leaf saltbush): resembles *Atriplex canescens* (see part III, B) but leaves are small.

*Celtis pallida* (desert hackberry): Up to 6 m tall. Leaves dark green, elliptical to oval, toothed or untoothed, up to 3 cm long and 19 mm wide.

*Fouquieria splendens* (ocotillo): Up to 6 m tall. Leaves green, oval, up to 5 mm long. Most of the year canes are leafless.

*Larrea tridentata* (creosote bush): Up to 3 m tall. Leaves dark green to yellow-green, waxy, resinous, 2 leaflets joined at base, up to 10 mm long. Strongly scented.

*Lycium sp.* (Wolf-berry): Branches usually spiny. Leaves in clusters. Leaves shaped from nearly cylindrical to flat. Leaves fleshy.

*Simmondsia chinensis* (jojoba): Up to 3.5 m tall. Leaves grayish green, leathery, thick, and elliptical, up to 4 cm long.

*Trixis californica* (trixis): Up to 1 m tall. Leaves dark green, lance-shaped, smooth edged or toothed, up to 5 cm long and 13 mm wide.

*Ziziphus obtusifolia*: Spiny branches. Leaves alternate and in clusters. Leaves oblong or elliptical.

### Interactive Key:

An on-line interactive key for the native plants of South Mountain Park in Phoenix can be found at: <http://seinet.asu.edu/navikey/SouthMountainIndex.jsp>

### References

- Easy Field Guide to Common Desert Cactus of Arizona*. 1985. Primer Publishers, Phoenix.
- Fischer, P.C. 1989. *70 Common Cacti of the Southwest*. Southwest Parks and Monuments Association.
- Kearney, T.H. and Peebles, R.H. 1960. *Arizona Flora*. University of California Press, Los Angeles, London.
- Pinkava, D.J. and Lehto, E. 1970. *A Vegetative Key to the Cultivated Woody Plants of the Salt River Valley, Arizona*. Arizona State University Herbarium: Department of Botany and Microbiology. Arizona State University. Tempe, AZ.





## Common Ornamental Plants: Trees

*Arecastrum romanzoffianum* (queen palm). Arching, bright glossy green leaves, 4-6 m tall. Bark shaggy, leaves drooping.

*Brachychiton populneus* (bottle tree). Evergreen. Common name comes from the heavy trunk that is broad at the base and tapers quickly. Simple, smooth margined leaves, they shimmer in the breeze like aspens. Clusters of small, bell-shaped white flowers in May and June, woody fruits.

*Callistemon viminalis* (bottle brush) Native to Australia. Colorful flowers in dense spikes or round clusters. Lanceolate leaves with no teeth. Usually trimmed to look like a tree.

*Chilopsis linearis* (desert willow) Long, narrow, 5-13 cm leaves. Flowers trumpet shaped with crimped lobes. Flower color pink, white, rose or lavender. Flowers appear in spring and through fall. Attractive to birds.

*Citrus* (lemon, limes, limequats, mandarin oranges, oranges, kumquats, sour-acid oranges, tangelos, tangors, and blood oranges). Thick leathery leaves with a "wing" on the periole. Flowers 5 petals, white, fragrant. Some varieties can bear fruit twice a year.

*Cycas revoluta* (Sago palm). 0.5-1 m tall, lacey appearance of a fern, related to conifers, produces cones. Leaves divided into many narrow, leathery, dark glossy green segments.

*Eucalyptus* (sugar gum, white box). Most widely planted non-native tree. Over 50 species. Some produce beautiful flowers. Silvery bark that peels in patches and long gray-green leaves are fairly common.

*Ficus microcarpa* (Indian laurel fig). Evergreen trees. Long drooping branches thickly clothed with blunt-tipped leathery 5-10 cm long smooth leaves. Light rose to green new leaves, produced almost continuously give the tree a two-tone effect. Light gray bark. Also popular: fiddle leaf fig (leaves shaped like a fiddle), *Ficus nintiada* (great for wind and noise break, fast growing, looks like *Ficus microcarpa*, but with sharply pointed leaves).

*Fraxinus* (Ash) Used as shade, lawn, and patio shelter trees. Leaves are divided into leaflets. Leaves 20-38 cm long. Usually paler beneath. Leaflets can range in number from 5 to 9 and can be smooth or toothed, wide or narrow.

*Olea europaea* (olive). Tree with bicolor willow-like leathery leaves. Produce fruits with valuable oil. Can withstand heavy pruning, so it is often seen in interesting shapes.

*Phoenix dactylifera* (date palm). Very tall (up to 24 m) with slender trunk and gray-green waxy leaves. Leaflets stiff and sharp pointed. Natural habit is to clump in several trunks.

*Pinus* (Pines). Various pine trees are planted around the valley including: sugar pine, ponderose pine, white pine, allepo pine, and Indian longleaf pine.

*Thevetia peruviana* (yellow oleander). Leaves 7-15 cm inches long, very narrow, with edges rolled under. Leaves are deep green, glossy, with inconspicuous veins. Fragrant flowers bloom any time, yellow to apricot, 5-7.5 cm inches long, tubular shaped.

*Vitex agnuscastus* (monk's pepper, chaste tree). Small tree, leaves are divided fan-wise into five to seven narrow 5-15 cm long leaflets that are dark green above, gray beneath. Flowers are 18 cm spikes of lavender blue flowers that appear in the summer and fall.

*Washingtonia filifera* (California fan palm). Always grows near springs or most spots. Long-stalked leaves have spines, leaflets are fan shaped.



## Common Ornamental Plants: Shrubs

*Bougainvillea*. Bougainvillea's vibrant colors come not from its small flowers, but from the three large colored bracts that surround them. This plant can be found in shrub or wall cover/vine form. It has large triangular smooth leaves and spines.

*Caesalpinia pulcherima* (red bird of paradise). Dark green leaves with many long leaflets. Orange-red blooms throughout warm weather.

*Calliandra eriophylla* (fairy duster, false mesquite). Leaves finely cut into leaflets. Flower clusters show pink or red stamens in puffy balls about 2.5 cm across. Blooms in Feb. or March.

*Carissa grandiflora* (Natal Plum). Fast-growing, strong, rounding shrub with lustrous, leathery, green, 7.6 cm oval leaves. White fragrant flowers with five-petal star shape, appear throughout the year followed by fruit.

*Cassia* (senna). Flowers may be yellow, bright yellow, egg-yolk yellow, deep yellow, or gold. Leaves are usually divided into leaflets and different species range from dark green to gray leaves. Feathery Cassia is one of the most common landscape plants; leaves are gray, divided into six to eight needlelike 2.5 cm inch long leaflets.

*Hibiscus rosa-sinensis* (tropical hibiscus). Evergreen shrub. One of the showiest flowering shrubs. Glossy leaves varies somewhat in size and texture depending on variety. Summer flowers can be single or double ranging from 10-20 cm wide. Colors range from white/red/yellow/apricot/orange.

*Leucophyllum frutescens* (Texas ranger, Texas sage, White Cloud). Compact slow-growing, silvery soft leaves with bell-shaped flowers blooming various times of the year (depending on rainfall)

*Nerium oleander* (oleander) very common shrub, simple, dark green, leathery glossy, leaves. Flowers 5-7 cm across white/pink/salmon/red. Can be trimmed to look like a tree.

*Pittosporum tobira* (mock orange). Broad dense shrub or small tree. Leaves leathery, shiny, dark green, rounded at edges with a ridge down the middle vein. Clusters of creamy white flowers form at branch tips in early spring and smell like orange blossoms.

*Ruellia* (ruellia). Shrub with opposite, toothed, purplish leaves that drop if it becomes too dry. Flaring bell-shaped flowers, usually deep purple.

*Tecoma capensis* (cape honeysuckle). Leaves divided into many glistening, dark green leaflets. Brilliant orange-red tubular, 5 cm blossoms that grow in compact clusters from October through winter. Can have yellow flowers and lighter green foliage.



## Ornamental Plants: Ground Cover

*Dalea greggii* (trailing indigo bush). Fast-growing evergreen shrub with pearl gray foliage. Clusters of tiny purple flowers in spring and early summer. Found as ground cover in many desert landscapes because it tolerates heat and lack of water once established.

*Hesperaloe parviflora* (hesperaloe). Makes a dense yucca-like clump of very narrow, sword shaped leaves, 1.22 m long to 2.54 cm wide. Pink to rose red, 3 cm nodding flowers in slim 1-1.2 m high clusters bloom in early summer. Leaves usually have slender thread peeling back at edges which looks like curled up dental floss.

*Lantana*. Fast growing, valued for profuse show of color over long season. Yellow, orange, red, pink, lilac flowers form 2.5-4 cm clusters. Dark green leaves 2.5 cm long with coarsely toothed edges. Grows in vining pattern usually seen as a ground cover.

*Myoporum parvifolium* (Myoporum). Bright green, 2.5 cm leaves completely cover plant. White summer flowers are followed by purple berries. Does not recover well from foot traffic.

*Rosmarinus officinalis* (rosemary). Narrow, aromatic leaves, glossy dark green above, grayish white beneath. Small clusters of light lavender blue flowers attract birds and bees. Used frequently for ground or bank covers.