GENERAL INTRODUCTION TO NATIVE DESERT PLANTS

The desert environment is characterized generally by high temperatures, low and inconsistent water availability, low relative humidity, high solar irradiation, and strong winds. Desert plants must be structurally and physiologically adapted to decrease or prevent a strain when subjected to the harshest environmental stresses. Each species has developed features to avoid and to tolerate detrimental stresses.

A plant needs energy at all times to survivie. If a plant just sits out in the middle of a desert, it still must expend energy for basic physiological processes. Therefore, one expects to find that each species is adapted to produce as much sugar as possible while using the least amount of water, i.e., high water use efficiency. At the same time plants must avoid damage to cell protoplasts by high temperatures (over 43°C). To avoid high temperatures, plants cool themselves by transpiration, the loss of water through the stomates. Thus, while the plant needs to save water, it also must use water frivolously for cooling, as in evaporative cooling of homes. The bottom line is that one has to lose/use water to make sugars because the stomates must be open to allow entrance of carbon dioxide and transpirational cooling. This gives the student some insight into the complexity of plant design. Each plant's design is closely attuned to its particular life style and year-round physiological behavior, so classification of the various designs is highly artificial and simplistic.

What are the general attributes of a lowland desertscrub?

1. Few, if any, trees are present, and trees are often succulents or otherwise nonsucculents with deep root systems. The largest nonsucculent trees are generally found where water accumulates, e.g., in depressions or along arroyos. Palms in southwestern deserts occur where there are permanent water seeps and springs.

2. Shrubs and trees are often very spinescent. Spines and thorns are formed by the evolutionary conversion of leaf parts or young branches into sharp appendages.

3. Shrubs and trees generally have relatively small leaves in comparison to related plants from wetter environments, and some are leafless through most of their lifetime.

4. Except in the wettest desert regions, e.g., grassland habitats, herbaceous ground cover is not well developed in the dry seasons. Herbs often are conspicuous following heavy rains.

5. Growth responses of desert perennials are often very rapid following appropriate rainfall.

6. Roots of many desert shrubs are very close to the soil surface. Rain penetrates only short distances into the soil, and plant roots form in that zone where water uptake is possible.

7. Critical stage in the life history of desert perennials is during establishment. Death by desiccation is very common during the first few weeks or months, but once established, desert perennials are commonly very tolerant of drought, often more so than freezing.

Some nonsucculent desert shrubs and trees.

1. Some species of shrubs in deserts are evergreen, i.e., young leaves are always present on live shoots even though some leaves drop in extreme drought. These leaves are compact, packed with chlorophyll-bearing palisade cells, and can photosynthesize in all seasons of the year. After a heavy rain, these species often exhibit high rates of photosynthesis and transpiration. Such plants are tolerant of very low water content and status and are, consequently, very successful desert perennials.

   Examples: Larea tridentata, creosote bush; Simmondsia chinensis, jojoba.

2. Some desert shrubs are seasonally dormant, lacking leaves during some stressful period of the year. One common design is called long shoot-short shoot organization. In these, the plant is composed of long stems, sometimes without any side branches, along which are axillary buds that produced clusters of leaves every year. Some species have fairly large leaves that persist only a couple months (examples Fouquieria splendens, ocotillo, and Jatropha cardiophylla, limberbush). Ocotillo usually produces leaves in spring after flowering, but may put out leaves twice a year; limberbush produces leaves and flowers in response to summer rains.

3. A fairly large group of desert perennials avoid drought by losing their leaves, even small and large branches, during the dry and cold seasons through shedding. Shoots are then restored during periods of favorable rainfall and temperature. These plants have high rates of photosynthesis on young shoots.

   Examples: Franseria deltoidea and A. dumosa, bur-sage; Artemisia tridentata, sagebrush; various small hemispherical members of the sunflower family, e.g. Zinnia and Psilotrophe.

4. In both the Old and New World deserts researchers have found unarmed shrubs with leaves that are seasonally dimorphic, large and mesomorphic when water is plentiful and small and more hairy when water status is low.

5. Another group of shrubs and small trees have rigid, spine-tipped branches with tough leaves that are usually winter deciduous, i.e., sensitive to freezing, but some are also sensitive to drought.

   Examples: Celtis pallida, desert hackberry; Condalia spp., gray-thorn.

6. A variety of desert shrubs and trees have photosynthetic old stems, i.e., large, nonsucculent stems have bright green bark. Some have rigid, spine-tipped photosynthetic branches lacking leaves because they are shed very soon after they form (Examples: Koeberlinia spinosa, junco; Castela (Holacantha) emoryi, crucifixion thorn; Canotia holacantha, canotia). Even more common are the woody plants with long photosynthetic old stems that are not as spiny and stiff, on which leaves or parts of leaves are present during moist seasons but shed usually in the winter. Examples are Cerdicium spp.,palo verdes; Parkinsonia aculeata palo verde. Other

common perennials with green stems are sometimes called brooms; these shrubs have typical bark at their bases but produce green flexible stems with small leaves. The leaves may function in photosynthesis for part of a season (Examples: Baccharis sarothroides, desert broom; Ephedra spp., Mormon tea. Some small shrubs have flexible, unarmed stems that are photosynthetic for several years but which eventually die back to the base and which have ephemeral leaves (Asclepias spp., desert milkweed).

7. In the Sonoran Desert one finds several tree species with very thick stems and fairly large, mesomorphic leaves that persist one growing season. The plants have long shoot-short shoot organization, and they have peeling (exfoliating) bark. When one strips off the outer layers of bark, the inner bark is bright green and photosynthetic.

   Examples: Pachycormus discolor, elephant tree; Bursera microphylla and B. fagaroides, cuajiotes.

8. Several large woody perennials that have large leaves live in the deserts of North America. The leaves are generally shed in the winter when moisture and temperature are not adequate to continue photosynthesis. Many of these have deep roots so that they tap underground water.

   Examples: Prosopis spp., mesquite and screw-bean; Chilopsis linearis, desert willow; Acacia greggii, catclaw; Sapindus saponaria, soapberry; probably the large leaved perennial Franseria ambrosioides, ragweed. Other plants from moister climates that live in desert riparian habitats are Populus fremontii, desert cottonwood; Salix spp., willow; Juglans major, Arizona walnut; Platanus wrightii, sycamore.

Perennial succulents with crassulacean acid metabolism (CAM).

1. Most of the succulents familiar to students in Arizona are the cacti, which have no noticeable leaves and instead photosynthesis is carried out in succulent, enlarged stems. Transpiration is greatly reduced by adaptations of the skin, and the stem holds large quantities of water, which is constantly recycled.

   Examples: Cactaceae, cacti; Idria columnaris, boojum.

2. Other perennial succulents have large, juicy leaves, in which photosynthesis is carried out.

   Examples: Agave spp., century plants; certain species of Yucca, relatives of joshua tree; Crassulaceae, hens-and-chickens.

Other rosette monocotyledons with large leaves.

Common plants of desertscrub and also desert grassland are the large rosette monocotyledons of the genera Agave and Yucca, mentioned above, and Dasylirion, sotol, and Nolina, beargrass.

Geophytes, perennial plants that die back each year to an underground storage structure (root, tuber, corm, rhizome, etc.).

These geophytes are often surprising because they have very large leaves. Remember, however, that they escape the stressful periods by remaining underground and grow when conditions are ideal.

Examples: Hesperocallis undulata, desert lily; Calochortus, mariposa; Peniocereus greggii, night-blooming cereus cactus; Erythrina flabelliformis, coral bean.

Perennial grasses that die back each year.

Parasitic flowering plants on perennial shoots of desert trees and shrubs.

Examples: Viscaceae and Loranthaceae, mistletoes; Cuscuta, dodder.

Epiphytes with xeromorphic adaptations.

Example: lichens; Bromeliaceae, spanish mosses.

Resurrection plants, perennial plants in which the leaves can dry out and then rehydrate to regain physiological processes.

Examples: Selaginella spp.; Notholaena spp.; Cheilanthes spp.