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THE SAGUARO CACTUS

AT

SAGUARO NATIONAL MONUMENT

The saguaro is one of some 2000 species of the family Cactaceae which naturally are confined almost entirely to the two American continents and associated outlying islands. The majority of these species occur in tropical and subtropical climates in environments that range from humid to extremely arid. All available evidence indicates that the family originated on the American continents in a tropical or subtropical environment. On the evolutionary scale, the cacti are relative newcomers to the plant kingdom and are still actively evolving -- hybrids and ecotypes are common, as is disagreement among taxonomists.

The saguaro cactus is the northernmost species in a large group of tropical columnar cacti which, in Arizona, also includes the organ-pipe and senita. As a major plant dominant in a subtropical desert, the geographic distribution of the saguaro is primarily to the south where it occurs throughout the mainland Sonoran Desert into the subtropical deciduous "thorn forest" of the State of Sonora, Mexico. The saguaro is not continuously or uniformly distributed within its general range. It is associated primarily with rocky soils of intermontane valleys. The plant occurs only in the region of pronounced biseasonal (summer and winter) rainfall and appears to be limited in its westward distribution (the lower valley of the Colorado River) by the near absence of summer rains.

In Tucson, the saguaro population occurs near the northeastern sector of the species range. In the Rincon Mountain Section of Saguaro National Monument, the plants are growing at the edge of the desert, for contrary to popular belief, Tucson does not lie near the heart of the Sonoran Desert.

Although a few cactus species occur in regions with severely cold winters, most are limited to warm, relatively frost-free environments. The saguaro which occurs only in the Sonoran Desert is one of this cold intolerant group. Although well adapted to heat and drought, the saguaro cannot tolerate severe subfreezing temperatures. Freezing of tissues and ultimate death results from prolonged exposure to temperatures lower than 25° F. The northern and eastern limits of its distribution in the United States occur along a clearly definable line -- the line beyond which subfreezing temperatures occasionally persist for more than 19 consecutive hours. Winter climate is the primary control on saguaro populations at Saguaro National Monument, and the freezing temperatures selectively remove the largest and smallest (the oldest and youngest) saguaros from the population. Analysis of the climatic record shows that since the end of the 19th century saguaros in the Tucson area have been subjected to the devastating impact of frequently reoccurring catastrophic freezes. High saguaro mortality was not uniformly distributed within the Saguaro National

National Monument habitats. Stands situated in localities of cold air drainage and accumulation (marginal habitats), and on the slopes at certain elevations were most severely affected. Other stands, notably those growing at other elevations and/or on rocky south-facing slopes, were relatively undamaged, and continue to survive in apparently undiminished densities. Such habitats seem to offer the highest potential for the continuing success of the species in Saguaro National Monument

In the Tucson area blooms appear on the tips of the stem and arms (branches) of the plant in late spring, reaching a peak in late May. The large, showy flowers which open in late evening and close the following day are pollinated by a variety of organisms including bats, birds and the introduced European honey-bee. Fruit ripening and seedfall begins in June and reaches a peak in early July. A large plant may produce several hundred fruits, each weighing approximately 2 ounces and containing an average of more than 2000 seeds enclosed in a sweet, succulent, red matrix. Ripening at a critical time when other succulent foods and other sources of water are scarce, large quantities of the fruits are consumed on the plant by several species of birds including curve-billed thrashers, woodpeckers, and particularly, white-winged doves. Fruits which fall to the ground are also heavily utilized by such diverse kinds of consumers as harvester ants, ground squirrels and other rodents, and even coyotes. Although such consumption may account for a major portion of the annual seed crop, some of these agents perform a beneficial function, disseminating viable seeds passed through their digestive tracts. Perhaps less than one-in-a thousand seeds produced ever reaches a site where it germinates.

The peak of fruit ripening and seed-drop coincides with the onset of summer monsoon rains which sweep into the region from the Gulf of Mexico in early July and continue erratically into August and early September. These are the germination and early establishment rains. Normally, germination (as observed) takes place following the occurrence of two or more substantial rains within a 2 to 5 day period, providing sufficient precipitation to maintain nearly continuous conditions of high humidity and free water at the soil surface necessary for seed germination. Under laboratory conditions germination can occur in 48 hours or less. In the field, however, 4 days is the minimum time between initial wetting and observed seedling emergence.

The early mortality rate of seedlings is high; commonly half of them die from a variety of natural causes within a few weeks after germination. Most seedling deaths which occur during the first summer result from uprooting by birds and digging rodents (notably ground squirrels), consumption by insects, and lack of adequate moisture for continued growth. In marginal habitats such as north-facing slopes and areas of cold air drainage and accumulation (such as the Cactus Forest area of Saguaro National Monument) winter kill (freezing) occurs as a result of subfreezing nighttime temperatures. Few seedlings survive until the end of the first year of life. Those that do survive are normally intimately associated with rocks, litter or plants which provide concealment and physical protection from the environment, both climatic and biotic.

The growth rate of seedlings is highly variable and is controlled primarily by the availability of moisture immediately beneath the soil surface. Even on highly favorable sites, the initial growth is slow; stems attain a height of only 3 to 5 mm. (.12-.20 inches) during the first year and grow to an estimated height of 15 to 25 mm. (.60-1.0 inches) at 5 years. Growth rates of larger seedlings and juvenile plants have not been accurately determined. However, studies done in the Cactus Forest area provide the following information on estimated saguaro height-age relationships. The first blooms normally appear on plants 8 to 10 feet in height (age approximately 35-40 years). Initial branching occurs at heights of 16 to 22 feet (age approximately 64-94 years). Plants occasionally reach heights of more than 40 feet with the maximum age of such individuals estimated to be 150 to 200 years. As they approach the end of their life span, some plants appear to senesce, but the causes and role of senescence are poorly understood.

Seedling mortality drops sharply during the second and succeeding years of life as the surviving individuals in their comparatively favorable habitats outgrow the initially unfavorable elements of the environment. Deaths are few in number amongst young adult plants (those which have reached the age of reproduction). Larger saguaros however, are subject to an increasing number of climatic hazards as they become older and larger; primary causes of death include wind-throw, lightning, freezing (in marginal habitats) and, possibly senescence.

Historical factors -- human abuses -- have unquestionably affected imbalances in the biotic communities of the Monument, some doubtless importantly affecting saguaro populations. Known historical activities within the saguaro habitats of the Cactus Forest area include the cutting of paloverde and mesquite trees for use as fuel, predator control, and livestock grazing. In addition, apparently large numbers of small saguaros were removed for use in landscaping Tucson residences. In each case, the historical record is sketchy and offers, at best, a meager basis for assigning quantitative values to each factor. Still more forbidding and fraught with chance of error is the task of evaluating the probable individual effects of these activities, the interactions produced, and finally, of separating these effects from the natural dynamics of the saguaro population, the community and the environment.

The questions and pressures related to human abuse and fluctuations in the Saguaro National Monument saguaro population are concerned not only with historical factors, but with continuing activities. Although livestock have been fenced out of the Cactus Forest area since 1958, cattle still grazing upon the slopes of the Rincon Mountains and certainly, regardless of the results of evaluations by range managers, the impact is real and genuinely detrimental to the National Park Service objective of maintaining representative natural biotic communities in a natural environment. Predator control (including the killing of snakes) continues. Urbanization of the surrounding

area continues at a rapidly growing rate, and smog is increasing. The increasing visitor use of the Monument leaves its mark upon the environment, and the destruction of young saguaros by vandals mounts. All are factors worthy of concern, and must be the subject of appropriate management programs.

Amidst this somewhat bleak picture, some encouraging changes have occurred. Grazing has been eliminated from large areas of the Monument including some of the rocky foot slopes of the Rincon Mountains and all of the Cactus Forest section. In the latter area, natural recovery of the vegetation is evident, especially with respect to desert grasses and nonarbooreal perennial species. The appearance of numerous small saguaros which have become established in parts of this area during the fourteen years since cattle were excluded strongly supports the wisdom of that action, and equally strongly suggests the importance of the early elimination of cattle grazing from all of the remaining habitat