ORGAN PIPE CACTUS

Overview

The organ pipe cactus (*Stenocereus thurberi* [Engelm.]), a 3-8-meter high columnar cactus, is rare in the United States and grows wild only in Arizona in the Sonoran Desert. Despite its restricted range in the U.S., *Stenocereus thurberi* is one of the most common of the more than 100 species of columnar cacti in the world, and it is the most common columnar cactus in mainland northwestern Mexico (Yetman 2006). The majority of the U.S. organ pipe cactus population occurs in the Organ Pipe Cactus National Monument (ORPI) along with two other species of columnar cacti, senita (*Pachycereus schottii*) and saguaro (*Carnegia gigantea*). Within ORPI, the organ pipe is widespread on rocky slopes and upper bajadas, with highest numbers occurring on southwestern, southeastern, and southern slopes where freezing temperatures are least likely to occur (Parker 1987). Throughout its range, the organ pipe's flowers and fruits are vitally important to migrant and resident animal species that depend on nectar, pollen, and fruit during the summer months. Organ pipe fruits have long been used by humans; they are eaten fresh, dried, and made into wine.

Distribution

In the U.S., the organ pipe cactus occurs only in Arizona and only in one corner of the Sonoran Desert. As noted above, most of the organ pipes in Arizona occur within ORPI, established in 1937 primarily to protect the species. A small number of the cacti grow outside of the monument in western Pima and southwest Pinal Counties. They occur no more than 100 miles north of the U.S./Mexico border (Yetman 2006). The limiting factor for the northern distribution is thought to be winter freeze events.

Figure 1. Distribution of organ pipe cacti. After Yetman (2006)

RESOURCE OVERVIEW

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Although organ pipes are rare in Arizona, they are abundant in Mexico only a short distance south of ORPI. Organ pipes occur south through Sonora (where they are called pitayas) and the northwestern portion of Sinaloa. They disappear entirely about 175 miles south of the Sonora-Sinaloa state line, where rainfall is too great (Yetman 2006). They also become less abundant and disappear to the east in southern Sonora, in the foothills and mountains of the Sierra Madre Occidental (due to more abundant rainfall and denser vegetation). The organ pipe's range also includes the lower half of Baja California. The range shows a dependence on predictable warm-season rains.

The organ pipe cactus has occurred in what is now Arizona for about 3,500 years, compared to the saguaro which has existed there for about 10,000 years (Yetman 2006). The saguaro is able to tolerate colder temperatures.

Physical Description

Stenocereus thurberi is a 3-8-meter high columnar cactus with many vertical stems; in the northern part of its range the stems originate from the base, and in the southern part of its range they originate from a short trunk (Turner et al. 1995). The vertical stems, or branches, are 15-20 cm in diameter and have 12-19 rounded ribs. One of the most obvious distinguishing features of the organ pipe cactus is that the branches are thinner than all but one of the other columnar cacti (the senita, which has fewer ribs) (Yetman 2006). The plant's spines are 1.2-2.5 cm long and clustered

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Mature Organ Pipe Cactus usually have many verticle stems

in areoles (raised structures on the stems). Organ pipes have 7-9 radial spines (around the edge of the areole) that are about 1 cm long, and 1-3 central spines, with the bottom one being 2-5 cm long. New spines are reddish to dark brown or black and turn gray with age. The areoles are about 1-3 cm apart, and they often have a notch or indent between them. The areoles near the ends of the arms are most often covered with a brown to black resin.

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Organ pipe cactus spines

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Organ pipe cactus flower

Buds and flowers sprout from the areoles along the upper portions of branches. Organ pipe buds are smooth and greenish red to greenish pink. The 6-8 cm long flowers are white or pale pink to lavender and funnelform in shape. They open only for one day. The nectar chamber provides enough nectar for multiple pollinators during the night. The globose fruits are 4-7.5 cm in diameter and contain reddish pulp and numerous black seeds.

Ecology

Habitat

The organ pipe cactus is sensitive to frost. In the U.S. organ pipes grow below 3300 feet in elevation, primarily on south-facing slopes. There they receive the benefits from the morning sun in winter and warm air rising from below (Parker 1987; Yetman 2006). The rock substrate on which they grow also absorbs and retains heat. Most locations where organ pipes grow experience maximum temperatures of more than 100º F (38º C).

Seedlings in the northern part of the range do best when under the protection of rocks or a nurse plant, which can protect a seedling from temperature extremes. At ORPI, only a small proportion (15%) of plants shorter than 0.5 meters grew where they were unprotected (Parker 1987). Nurse plants at ORPI included *Cercidium microphyllum* (Torr.) (foothill paloverde), Olneya tesota Gray (ironwood), Ambrosia deltoidea (Torr.) (triangle-leaf bursage), and Fouquieria splendens Engelm (ocotillo).

Life History

There are about 23 species of cactus in the genus Stenocereus. These species range in size from one that grows flat along the ground (S. eruca of the Magdalena Bay region of Baja California) to one that reaches 15 m (50 feet) in height and possesses a thick trunk (S. chacalapensis of the Oaxacan coast) (Yetman 2006). Most states in Mexico contain at least one species of *Stenocereus*.

Two columnar cacti (S. martinezii and S. quevedonis) and the semicolumnar cactus S. benekei are the organ pipe's closest relatives (Yetman 2006). The organ pipe shows some similarities to the other two columnar cacti (e.g., similar flowers, edible fruits, all usually having a horizontal notch or crease between the areoles), although their habits are different. According to Yetman (2006), the organ pipe probably evolved from S. martinezii. The organ pipe has a greater range and abundance than S. martinezii and S. quevedonis, and its range does not overlap with these two relatives.

For the first few years of an organ pipe cactus' life, the plant grows into a distinct column but remains tiny (Yetman 2006). A plant usually does not produce branches until it is almost 30 years old. There are scant data on or-

Photo credit: Tim Tibbitts

The lesser long-nosed bat, shown here covered in agave pollen, is an important pollinator of organ pipe cactus.

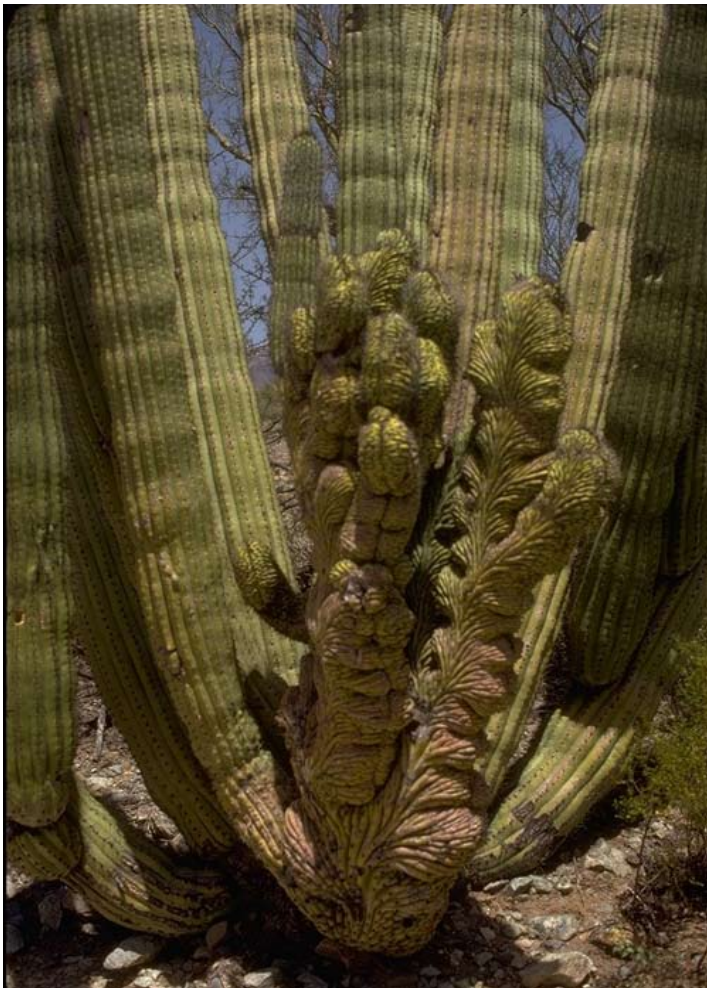
gan pipe ages in Mexico, but some large lowland plants in southern Sonora are reportedly more than 100 years old. At around 20 years of age at ORPI, an organ pipe is about 1 m tall. Plants grow faster in the southern portion of the range compared to the northern portion; average growth in El Pitayal (a dense and mature forest of pitayas in Mexico) in the south was 0.12 cm (0.48 inches) per day, compared to 0.030 cm (.012 inches) per day near ORPI. In the northern part of the range (at ORPI), most plants reach reproductive age when they are 2-2.5 meters tall (Turner et al. 1995). At this point in time, most plants have about 4-10 arms

The average number of flowers, fruits, and seeds produced per plant varies across the range; an average of 100 flowers per plant per year, with an average of 24 mature fruits and 8400 seeds, was reported for the Kino Bay area (central Sonora; Fleming 2002, as cited in Yetman 2006). Successful flower pollination is lower in the organ pipe cactus than in other columnar cacti inhabiting the Sonoran Desert.

Ecological Role

Throughout its range, the organ pipe's flowers and fruits are vitally important to migrant and resident animal species that depend on nectar, pollen, and fruit as a major dietary component during the summer. The organ pipe cactus flowers from approximately May to June, at which time the flowers open after sunset and close the following morning. The endangered lesser long-nosed bat (Leptonycteris curasoae) is of known importance as a pollinator (e.g., ORPI 2006; Bustamonte and Burquez 2007), and Choeronycteris mexicana and Leptonycteris sanborni, two nectar-feeding bats, are noted as potential pollinators (Turner et al. 1995). In some sites across the cactus' range (see below), hummingbirds have been reported as the main pollinators.

A recent study examined the organ pipe in three populations in the north, south, and central portions of its range in Sonora, Mexico (Bustamante and Burquez 2007), with the northern study population just south of the Arizona border. The researchers found that the time period for flowering varied among the populations, with that in the northern area beginning later and lasting the shortest time (two months). Although pollination by bats is most prevalent for the organ pipe overall, Bustamante and Burquez (2007) found that the relative importance of nocturnal versus diurnal pollinators varied geographically. Flower visitors generally included nocturnal beetles, bats (mostly Leptonycteris curasoae), moths (including the sphingid Hyles lineate), diurnal honey bees (Apis melifera), perching birds, and hummingbirds. Four common perching birds were: the gila woodpecker (Melanerpes uropygialis), the curve-billed thrasher (Toxostoma curvirostre), the northern cardinal (Cardinalis cardinalis), and the cactus wren (Campylorhynchus brunneicapil-



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Organ pipe cactus at Organ Pipe Cactus NM.

lus). The perching birds were most common early in the flowering season and less common once migrating hummingbirds (Calypte costae and Cyanthus latirostris) arrived. All of the birds mentioned here were observed at flowers in the south site, but only two were observed at the central site, and none were observed at the north site.

Fruits of the organ pipe mature during the summer. Throughout its range, a variety of animals feed on the fruit, including doves, Gila woodpeckers, white-fronted parrots (in the south), bats, coyotes, foxes, and humans (Yetman 2006). Fruit eaters disperse the seeds. A visible example of how bats help spread the species can be seen in the Pinacate Volcanic Range, south of the southwestern Arizona border (Yetman 2006). Bats have eaten the fruits and defecated the seeds during their flights to and from their roosts, leaving a path of cacti behind.

When organ pipe cactus stems rot, various yeasts and fruit flies (Drosophila sp.) inhabit the stems (Turner et al. 1995).

Status and Trends

Regeneration of organ pipe cactus over the last century has been irregular, with short incidences of recruitment during unusual wet periods (such as, the 1910s and 1920s) with mild winters. Poor regeneration has coincided with prolonged drought (Parker 1993). Concerns for the organ pipe cactus have generally included freezing temperatures and land use changes (Johnson et al. 1991). A decline in the frequency of freezing has been shown through climate monitoring at ORPI. If freezing incidents continue to decline, organ pipes may become more widespread throughout the Monument and southern Arizona.

In the northern range of the organ pipe, the endangered lesser long-nosed bat is one of the most important pollinators. However, maximum fruit set requires the contributions of the various pollinators, and if there is a decline in the population of one or more of the pollinators, a reduction in fruit set could occur (Fleming et al. 2001).

Within the U.S., most organ pipes are found within ORPI and Cabeza Prieta National Wildlife Refuge. The remaining individuals grow mostly on tribal lands of the Tohono O'odham and on lands managed by the federal and state government. Therefore, they are largely protected from harm in the U.S. In Mexico, the cactus is more widespread and vulnerable to clearing for agriculture and aquaculture (Yetman 2006).

Management

Monitoring

The organ pipe cactus is identified as a sensitive plant species within National Park Service boundaries. The overall objective for monitoring of special status plants at ORPI is to understand population dynamics and identify potential threats so that effective management can be carried out. A specific objective for columnar cacti, including the organ pipe cactus, is to determine if productivity (indicated by stem growth) is changing over time. A growth monitoring project began at ORPI in 1970. Personnel at ORPI measured annual growth of organ pipe individuals from 1970 to 1997, 2000, and 2002 to 2003. Parker (1988) analyzed the 1970-1983 data to examine growth in relation to plant size, age, and climate. She found that plant size and number of stems explained much of the observed variation in annual growth. Variation in average growth rates between years was positively correlated with previous winter (November-April) precipitation and negatively correlated with number of days with temperatures at or below freezing (November-March). Based on the entire dataset, ORPI (2006) reported a marginally significant decline in growth for one group of plants (the 11-20 stem-number class). The majority of the stem number classes (8 of 11) showed declining growth rates, but the growth changes were not statistically significant. The growth monitoring study was ended in 2005 in order to focus on broader ecological questions for columnar cacti in the Monument.

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Organ pipe cactus.