

## World Heritage Sites

### Protected Areas and World Heritage



## CARLSBAD CAVERNS NATIONAL PARK UNITED STATES OF AMERICA

*These caves within a Permian fossil reef in the karst landscape of southern New Mexico, form a network of 113 known caves including Lechuguilla Cave 494m (1,604 feet) deep and 180 km (112 miles) long. They are outstanding for the size, profusion, diversity and beauty of their mineral formations. Lechuguilla Cave provides an underground laboratory where geological and biological processes can be studied in a setting which is virtually intact.*

### COUNTRY

United States of America

### NAME

Carlsbad Caverns National Park

### NATURAL WORLD HERITAGE SITE

1995: Inscribed on the World Heritage List under Natural Criteria vii and viii.

### STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee issued the following statement at the time of inscription.

#### Statement of Significance

The more than 100 limestone caves within Carlsbad Caverns National Park are outstanding and notable world-wide because of their size, mode of origin, and the abundance, diversity and beauty of the speleothems (decorative rock formations) within. On-going geologic processes continue to form rare and unique speleothems, particularly in Lechuguilla Cave. Carlsbad Caverns and Lechuguilla Cave are well known for their great natural beauty, exceptional geologic features, and unique reef and rock formations. The Permian-aged Capitan Reef complex (in which Carlsbad Caverns, Lechuguilla and other caves formed) is one of the best preserved and most accessible complexes available for scientific study in the world.

**Criterion (vii)** The park's primary caves, Carlsbad and Lechuguilla, are well known for the abundance, diversity, and beauty of their decorative rock formations. Lechuguilla Cave exhibits rare and unique speleothems, including a great abundance of large calcite and gypsum formations, including the largest accumulation of gypsum "chandeliers," some of which extend more than six meters (18 feet) in length.

**Criterion (viii)** Carlsbad Caverns National Park is one of the few places in the world where on-going geologic processes are most apparent and rare speleothems continue to form, enabling scientists to study geological processes in a virtually undisturbed environment. These speleothems include helictites forming underwater, calcite and gypsum speleothems, and an astonishing collection of "biothems," cave formations assisted in their formation by bacteria. Researchers can study both the Capitan reef's inside through cave passages that penetrate in and through it as well as eroded canyon-exposed cross sections outside.

### IUCN MANAGEMENT CATEGORY

II National Park

### BIOGEOGRAPHICAL PROVINCE

Chihuahuan (1.9.7)

### GEOGRAPHICAL LOCATION

Located in the foothills of the Guadalupe Mountains near the New Mexican border with Texas, 200 km east-northeast of El Paso, centred on 32°10'N by 104°23'W.

## **DATES AND HISTORY OF ESTABLISHMENT**

- 1898: J. White first discovered and explores the Caves;
- 1923: 291 ha created a National Monument by Presidential Proclamation 1679;
- 1930: Designated a National Park by the U.S. Congress under Public Law 216 with boundaries enlarged;
- 1930-1963: Further boundary adjustments made;
- 1978: 13,406 ha designated as wilderness under Public Law 95-625;
- 1993: 2,541ha of public land along the northern boundary withdrawn from mineral leasing, exploration and development by the Lechuguilla Cave Protection Act, U.S.Congress Public Law 103-169 (USDI-NPS, 1994).

## **LAND TENURE**

The Federal government owns 18,788 ha; 137 ha are privately owned. The site is managed by the National Park Service (NPS) of the Department of the Interior.

## **AREA**

18,926ha (46,766 acres)

## **ALTITUDE**

1,095m to 1,987m (3,559'-6458"). Greatest depth 318m (1,034 ').

## **PHYSICAL FEATURES**

The Park overlies a segment of a 400 km long southwest-trending fossil reef that surrounds the Delaware Basin of southeastern New Mexico and western Texas which was a small reef-fringed inland sea in Permian times 280-250 mya. The reef was subsequently buried and preserved under layers of evaporite salts and sediments and between 65 and 6 mya was uplifted to form the Guadeloupe mountains. Three sections, back reef, main reef and fore reef are still visible, built up mainly of algae and sponges, preserving within their mass a rich diversity of bryozoans, pelecypods, gastropods, cephalopods, echinoderms, brachiopods, fusulinids and trilobites. Several deep canyons eroded in the 750m-thick limestone Capitan reef reveal cross-sections of other formations which are also exposed within the extensive cave system. The most notable example is found in Lechuguilla Cave (discovered only in 1986) where five are identifiable: the Yates, Seven Rivers, Queen, Capitan Reef and Goat Seep formations.

Unlike most caves which are produced by carbonic acid dissolution, the Caverns developed as hydrogen sulphide gas from underlying oil and gas deposits seeped upwards and combined with fresh water to form sulphuric acid which eroded the limestone into unusually large chambers. Gypsum, a by-product of this process, has been deposited in a variety of forms throughout many of the caves, ranging from thin crusts to beds more than 30m (98.4') thick. Carlsbad Cavern with its large entrance and many miles of passages dropping over 310m (1,000') is the largest of the 113 known caves within the Park. Lechuguilla Cave is not only the deepest at 494m (1,604 feet) and longest at 193 km (121 miles), but contains the largest collection of hydromagnesite balloon-like formations, subaqueous helictite formations and calcite speleothems. The number and quality of the stalactites, stalagmites, draperies, columns, soda straws, and sulphate mineral deposits found throughout the caves is outstanding (USDI-NPS, 1994).

## **CLIMATE**

The Park has a semiarid, continental climate with cool winters and occasional snow and ice storms, windy springs and warm to hot summers. The mean annual temperature is 19°C (66°F), the average annual maximum is 23°C (74°F) and the average annual minimum is 10°C (50°F). The average annual rainfall is 366mm (14.3in) with a monsoon season from July through September when violent thunderstorms drop much of the annual rainfall.

The interior climate of the Cavern network is complex and is only stable far from the entrance. The main portion (the Main Corridor, Big Room and Lower Cave) is a cold trap in winter when cold and

usually dry air flows down from its mouth forcing warmer moist air up to the ceiling and out. Over time this has cooled the Big Room to an average of 56°F (13.3°C). The relative humidity there drops to 87.5% during winter but remains around 100% during summer when there is less airflow exchange. The climate at the cave's lowest points remains a more constant 68°F (20°C) with closer to 100% relative humidity. This is the case with Lechuguilla Cave, which is extremely large and deep with only one very small entrance, though it has subtle variations that cannot easily be explained.

## VEGETATION

The Park lies at the intersection of the southern Rocky Mountain, northern Chihuahuan Desert, and southwestern Great Plains biogeographic provinces and is one of the few protected parts of the northern Chihuahuan Desert, the largest and wettest of the North American desert ecosystems, which is predominantly a shrub desert without the large cacti and trees of the Sonoran Desert. It supports a diverse ecosystem, with habitat for many plants and animals at the geographic limits of their range. The lechuguilla *Agave lechuguilla* is the commonest indicator of Chihuahuan conditions. The Park's primary vegetation is a variety of grasslands and desert shrublands with scattered woodlands at higher elevations where the ponderosa pine *Pinus ponderosa* reaches its extreme eastern limit. The Park's list of vascular plants includes more than 900 species and subspecies.

The flora is typical of the northern portion of the Chihuahuan Desert. Species range from drought-resistant shrubs such as creosote bush *Larrea tridentata* and prickly pear *Opuntia* spp., sotol *Dasylirion wheeleri* and *Agave* spp. to walnut *Juglans* spp., hackberry *Celtis* spp., oak *Quercus* spp. and soapberry trees *Sapindus* spp. in the richer soil of the canyons. Coniferous forest with twoneedle pinyon *Pinus edulis*, checkerbark and redberry junipers *Juniperus deppeana* and *J. pinchotii* is found at higher elevations. The park also contains the following four globally threatened plants: shining coral root *Hexalectris nitida*, Sneed's pincushion cactus *Escobaria sneedii*, Lee pincushion cactus *E. leei* and Lloyd's hedgehog cactus *Echinocereus lloydii*. Other plants include giant helleborine orchid *Epipactis gigantea*, button cactus *Epithelantha micromeris*, Guadalupe jewelflower *Streptanthus sparsiflorus*, Harvard's gumweed *Grindelia havardii* and resurrection plant *Selaginella pilifera*. A total of 94 fungi species from over 30 genera have been identified from Lechuguilla Cave, and many other species from other caves.

## FAUNA

The deserts of the Southwest contain some of the greatest diversity of animals in the United States and the Park itself has a diversity of habitats, including permanent flowing water at Rattlesnake Springs. 67 mammals, 357 birds and 45 reptile and 9 amphibian species are recorded and 28 more species of reptiles and amphibians are tentatively identified; also 5 fish and at least 600 insect species (NPS, 2007). Of the 17 bat species, the seasonal breeding colony of Mexican free-tailed bat *Tadarida brasiliensis mexicana* is the most notable: its population is about a million bats which pour out to forage in the evenings. Other mammals include black footed ferret *Mustela nigripes* (EN: extinct in the wild but reintroduced), occasional western spotted skunk *Spilogale gracilis leucoparia* and American black bear *Ursus americanus amblyceps*, grey fox *Urocyon cinereoargenteus*, coyote *Canis latrans*, bobcat *Lynx rufus texensis* and occasionally puma *Puma concolor cougar*, javelina or collared peccary *Pecari tajacu angulatus* (reintroduced), pronghorn antelope *Antilocapra americana* (reintroduced), and mule deer *Odocoileus hemionus crooki*. There are two non-native introductions or escapees, Rocky Mountain elk *Cervus elaphus* and Barbary sheep *Ammotragus lervia* (VU). Merriam's elk *Cervus merriami* became extinct around the turn of the century, and desert bighorn sheep *Ovis canadensis nelsoni* were extirpated from the Park in the 1960s. Five other species may have been extirpated since European settlement.

The avifauna includes golden eagle *Aquila chrysaetos*, bald eagle *Haliaeetus leucocephalus*, scaled quail *Callipepla squamata*, Mexican spotted owl *Strix occidentalis lucida*, great horned owl *Bubo virginianus*, roadrunner *Geococcyx californina*, loggerhead shrike *Lanius ludovicianus*, and cave swallow *Petrochelidon fulva* of which the Cavern Natural Entrance has the largest colony in the northern hemisphere which breeds there in the summer. Rattlesnake Springs, a rare desert wooded riparian area, has been designated an Important Bird Area (IBA) by the National Audubon Society, and draws birders from around the world to see some of the more than 300 species that have been noted there. Of the reptiles, several of which are at the edge of their range, three species of rattlesnake *Crotalus* spp. are known to occur (USDI-NPS, 1994). An invertebrate inventory is available (USDI-NPS, 1994).

## **CONSERVATION VALUE**

The Park preserves physical and biological formations of great aesthetic and scientific value in one of the few protected parts of the northern Chihuahuan Desert. It has the largest cave chamber in North America in the Big Room, and Lechuguilla cave is the deepest and third longest limestone cave in the country. There are in the deep cave of Slaughter Canyon over 500 Archaic period Indian pictographs spanning at least three cultural periods, and pottery shards and artefacts from later Indian eras have been found throughout the Park, alongside the remains of an extinct Pleistocene fauna (USDI-NPS, 1994). The Park lies within a WWF Global 200 Freshwater Eco-region and is an Audubon-designated Important Bird Area.

## **CULTURAL HERITAGE**

Human occupation of the Guadalupe Mountains began with the arrival of a Palaeo-Indian hunting people around 14-12,000 B.C who left a stone scraper and two spear points of a Midland-style Palaeo-Indian projectile of some 10,000 years ago. These were followed by Archaic hunter-gatherers who settled in the region between 8000 BC and 1200 BC and by the Anazasi Basketmaker culture which left over 500 pictographs from three cultural periods in several caves, including the profusely decorated Painted Grotto, Upper Painted Grotto and Slaughter Canyon Cave. Pottery sherds, cooking ring sites and stone grinding tools, found at several of the Park's 125 archaeological sites, indicate that Indians living in the mountain region were influenced by other cultures such as the Jornada Mogollon to the west. In 1400 the Mescalero Apache settled the area just prior to the arrival of the Spanish who claimed the area between the 16th and 18th centuries. In 1821 Mexico took over the area until 1850 when the New Mexico Territory of the U.S.A. was established. During the first quarter of the 20th century a small bat-guano industry existed near the cave mouths (USDI-NPS, 1994).

## **LOCAL HUMAN POPULATION**

The land surrounding the Park's boundaries is now primarily used for ranching. However, oil and gas prospecting is likely to draw nearer to the area of the caves (NPS,2006).

## **VISITORS AND VISITOR FACILITIES**

Carlsbad Caverns have been attracting visitors since the 1880s. In 1994, approximately half of the Park's 617,087 visitors came during June, July and August (J. Thorsell, pers. comm., 1995) and the caves in 2007 draw more than 500,000 visitors a year (NPS). Present facilities include a visitor centre, parking, amphitheatres, picnic facilities, back-country camping and hiking trails. There are self-guided tours of the 8.2-acre Big Room and the Natural Entrance, and year-round guided tours of varying difficulty including crawls through narrow passageways in the Hall of the White Giant and Spider Cave. An unusual draw is the mass evening exodus of a million Mexican free-tail bats. The Park is accessible from U.S. Highway 62/180.

## **SCIENTIFIC RESEARCH AND FACILITIES**

Geologists have been studying the fossil reef for many years and the cave passages and canyons are constantly being surveyed, mapped and monitored. Recent biological research in Lechuguilla Cave led to the discovery of unusual micro-organisms in pools, hydroaerosols in the cave air, and suspected lithotrophic bacteria which may derive metabolic energy from sulphur, manganese, and iron and ecosystems dependent upon these autotrophic bacteria (Davis *et al.*, 1990; Cunningham, 1991; Northup *et al.*, 2000a, b). Ongoing research is looking into potential medical applications of these micro-organisms. The publication *Research in Carlsbad Caverns National Park* (1997) listed topics such as the relevance of cave bacteria to putative life on Mars, cave microbial life and climate, contamination from the ground facilities overhead, bat skeletons and wildlife on the surface. The discovery of the world's largest and most diverse collection of bacterially assisted speleothems found in Lechuguilla cave prompted calls for the establishment of a cave research institution which was founded in Carlsbad in 1998 as the National Cave and Karst Research Institute of the NPS. Scientists from all over the world visit the Park every year to study the structure and fauna of the reef. The caves are extremely well documented by scientific papers, books, newsletters and brochures. The archives in the Park museum contain about 1,000,000 cultural resource specimens and a herbarium containing approximately 1,200 vascular plant specimens.

## **MANAGEMENT**

The Park has two districts on the National Register of Historic Places: the Cavern Historic District and the Rattlesnake Springs Historic District. It is administered by the National Park Service and on-site management is the responsibility of the Superintendent. Each cave has been classified in one of six management categories. Category I covers highly developed caves such as those parts of the Caverns which provide visitors with maximum comfort and convenience: also minimally developed caves which provide relatively easy access with minimal modification of cave resources. Categories II to VI range from undeveloped caves which can only be visited with a National Park Service trip leader, to caves closed to use as they contain paleontological, archaeological or other resources of special scientific value. Many park caves are preserved and managed in a nearly pristine state to facilitate research. Guided tours rather than self-guided tours, have been introduced in the most delicate and fragile areas, to reduce human impact on the caves, and the use of security alarms to detect off-trail movement. There is also much increased ranger presence during the tourist season. The NPS completed a detailed General Management Plan in 1996 and planned to acquire the park land still in private hands (USDI-NPS, 1993).

## **MANAGEMENT CONSTRAINTS**

During the first 25 years of this century, the entrance chambers of some of the caves were mined for bat guano but adverse effects were minimal since it was a small operation using mostly hand held tools. Current disturbances include permanent damage to speleothems which are often either broken or become dulled from dirt and repeated touching; graffiti, wandering off-trail, the accumulation of lint and organic litter which causes increased bacterial growth, and the pollution of cave pools by coins and other litter. The use of lighting for tourism has led to the growth of algae, moss, fungi and vascular plants in some places. The atmospheric moisture content has been greatly disrupted through the use of elevator shafts. McLean (1971) reported that each year approximately 100,000 litres of water are lost from the caves in this way.

A decline in the bat population has been associated with the former use of DDT which has been found in residual quantities in surrounding agricultural land and continues to be used in Mexico, where the bats overwinter. The colony is also affected by attempts to eradicate them in Mexico, where bats are perceived to be a threat to humans and other animals. The Park's northern, southern and eastern boundaries were threatened by oil and gas exploration and the construction of transmission and storage facilities by the Bureau of Land Reclamation, prohibited by law since 1993 but still a potential source of contamination. Grazing by trespassing livestock, invasion by exotic barbary sheep and puma hunting have also occurred (USDI-NPS, 1994).

## **STAFF**

There were 85 permanent and 40 temporary employees in 1994 (USDI-NPS, 1994).

## **BUDGET**

The operating budget for the 1995 fiscal year was \$4 million (J. Thorsell, pers. comm., 1995).

## **LOCAL ADDRESSES**

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## **DATE**

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