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A Proposal for
Conservation of
Exemplary Stands of
the Giant Cardon
Cactus (*Pachycereus
pringlei* [S. Wats]
Britt. & Rose) in
Baja California Sur,
Mexico

Yoav Bashan¹

Center for Biological Research
of the Northwest (CIB)
P.O. Box 128
La Paz, Baja California Sur
23000 Mexico
bashan@cibnor.mx

¹ Other authors: Luz E. Gonzalez, Gerardo Toledo, Jose Luis Leon de La Luz, Gabor J. Bethlenfalvai, Enrique Troyo, Adriana Rojas, Gina Holguin, M. Esther Puente, Vladimir K. Lebsky, Patricia Vazquez, Thelma Castellanos, and Ellis Glazier

ABSTRACT: Four sites in the state of Baja California Sur, Mexico, support superb stands of the giant columnar cardon cactus (*Pachycereus pringlei* [S. Wats] Britt. & Rose). Giant cardon is not an endangered species in the region, but exemplary stands are rare and increasingly threatened by intensive agriculture and cattle ranching. We have identified four stands of cardon worthy of national protection. Three of the sites are located in the District of Loreto, and one is in the District of La Paz. The massive specimens of cardon that grow on these sites are unusually vigorous and healthy. The sites themselves are extremely scenic and accessible by tourists, are suitable for scientific study, and represent perhaps the best repositories of wild germplasm for the species. We recommend that these exceptional representatives of Mexico's national natural heritage be protected for future generations, as has been done in Arizona and California (USA) for saguaro cactus (*Carnegiea gigantea* [Engelm] Britt. & Rose) and Joshua tree (*Yucca brevifolia* Engelm.).

Index terms: cardon, *Pachycereus pringlei*, cactus, Baja California, desert conservation

INTRODUCTION

Giant cardon cactus (*Pachycereus pringlei* [S. Wats] Britt. & Rose) is the emblem of the Baja California Peninsula of Mexico. This majestic plant is widely distributed over the entire peninsula, often occurring in dense stands. It is difficult to visit Baja California without encountering scenic views framed by this arborescent cactus. Because the peninsula is sparsely populated and many areas are remote and difficult to access, most populations of cardon have remained intact through five centuries of European settlement.

The first description of cardon was by the Jesuit priest Miguel del Barco, founder of Mission San Javier, near the town of Loreto (del Barco 1768). In poetic prose, Don Miguel wrote

This tree, although full of moisture, is found only on dry lands, on level and sloped ground alike, provided that there is no moisture nearby, for this it shuns. . . . Whence then does it draw that moisture and the sap with which it is replete? Not from the rains, since these are very scant in California, and therefore, where there is no permanent spring and one must rely on rain-water alone, nothing can be sown or planted. . . . The cardon, however, even though years may pass without rain, shows no sign of distress: it perseveres serenely, with the same fresh green color and the same abundant sap, as ever.

Cardon is one of the most massive of all the cacti. An average mature cardon may reach a height of 10 m, but individuals as tall as 18 m are known (Leon de la Luz and Valiente-Banuet 1994). It is a slow-growing plant (Roberts 1989) with a life span measured in hundreds of years, but early growth can be increased significantly by inoculation with plant growth-promoting bacteria such as *Azospirillum* (Puente and Bashan 1993, Bashan et al. 1999, Carrillo-Garcia et al. 2000). Most adult cardon have several side branches that may be as massive as the trunk. The resulting tree with main stem and branches may attain a weight of 25 tons (Gibson and Nobel 1986).

The adult cardon cactus is adapted to the harsh climate of Baja California, characterized by drought and high temperatures, but as a seedling and juvenile it depends for survival on sheltering nurse plants such as mesquite (*Prosopis articulata* [S. Wats] Britt. & Rose) (Carrillo-García et al. 1999). In southern Baja California, cardon and other cacti are most prevalent on alluvial soils. Geomorphic structure and soil analysis indicate two major alluvial landforms in this region. An older surface (early Holocene in age), rich in carbonates and dominated by clay, is poor for the establishment of juvenile cacti. More recent alluvial surfaces (late Holocene in age), dominated by sand deposits, support populations of cacti with multistage structure: numerous juveniles established beneath the canopy of legume nurse trees (Valiente et al. 1995).

Giant cardon has great ecological value in the region. For example, the cactus may contribute to the stabilization of disturbed arid soils through its shallow, widely spreading, finely branched root system, which is capable of responding to rare rainfall episodes by rapid growth (Bravo-Hollis 1978, Nobel 1996, Bashan et al. 1999). The highly nutritious and succulent fruits of cardon, available in abundance during the desert dry season when other food sources are scarce (Valencia et al. 1985), are a major resource for many desert

birds and for the lesser long-nosed bat (*Leptonycteris curasoae*). The long-nosed bat is a major pollinator of the cardon's night-blooming flowers (Tuttle 1991).

THE PROBLEM

Two major factors threaten populations of cardon in Baja California Sur. First and foremost is agricultural establishment and expansion, which often involve the clearcutting and bulldozing of entire stands

of cardon. Second is a phenomenon of cardon decline, whose exact cause is yet unknown (Bashan et al. 1995).

Because cardon is so widely distributed throughout the Baja California Peninsula, it is not considered endangered. Yet, the currently known threats suggest a critical need to preserve some of the most magnificent stands of cardon. The combination of scenic beauty and presence of remarkable specimens of cardon makes some sites especially unique. These sites deserve to be preserved as local, national, and international treasures.

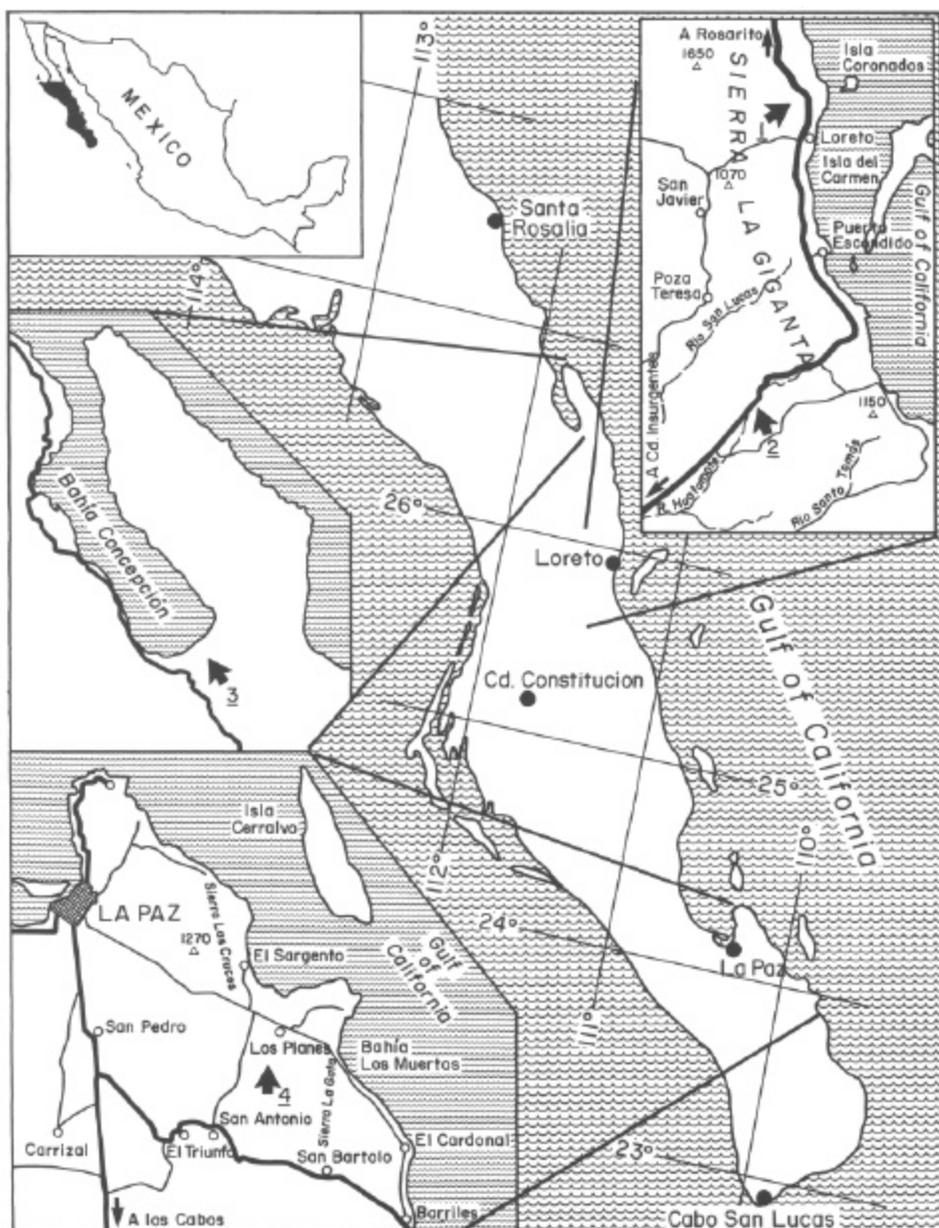


Figure 1. Map showing the location of the four areas recommended for protection of cardon in Baja California Sur, Mexico.

EXEMPLARY CARDON CONSERVATION SITES

We have identified four exemplary cardon sites in Baja California Sur (Figure 1) that should be protected immediately before human encroachment results in their destruction.

Site Number 1

The nearest population center to this site is the town of Loreto. Access is 8 km north of Loreto, on Mexico Highway #1. There, an unnamed dry-wash (arroyo) crosses the highway (entrance from the highway east-bound at 26° 04.44' N and 111° 22.63' W). The cardon stand extends inside the arroyo and on the valley slopes for 13 km; it ends in hills 216 m above sea level (asl) at 26° 03.82' N and 111° 28.68' W.

The arroyo has a dirt road running through it and is best negotiated by four-wheel-drive vehicle. The road serves three small cattle ranches within the dry wash. In addition to cardon, this wide arroyo has a great many large Palo blanco (*Lysiloma candida* Brandege) and Palo verde (*Cercidium floridum* Benth. ex A. Gray subsp. *peninsulare* [Rose] Carter) trees (Leguminosae). The stand of cardon at this site is notable for the great vigor and health of its individuals, which range up to 15 m in height, and for its picturesque association with the other trees (Figure 2).

Site Number 2

The towns of Loreto and Ciudad Insurgentes are the nearest populations centers to this



Figure 2. Typical stand of cardon with other plants at Site Number 1. Note human figure for scale.

site. South of Loreto, the site encompasses two small valleys formed by lava flows. Access to the first valley is at 45 km north-east of Ciudad Insurgentes on Mexico Highway #1, in front of the microwave tower "Agua Amarga" (25° 31.63' N and 110° 26.38' W; 612 m asl). The entrance to the second valley is at 58 km on Mexico Highway #1 from Loreto (25° 35.96' N and 111° 21.66' W; 333 m asl); the valley exits at 71 km on the same highway (25° 39.01' N and 111° 15.93' W; 402 m asl). The cardon stand is located along 5 km from the valley entrance. The valley bottom can be reached by a small dirt road that serves a small ranch.

Both sides of the valley are covered by a dense stand of cardon. A permanent stream flows through the valley, a rarity in this region. Although a cattle ranch occurs in the middle of the valley, damage to the vegetation may yet be reversible. The inaccessible slopes of the valley are relatively undisturbed.

Site Number 3

The nearest population center is the village of Mulege. Access to this site is 81

km north of the town of Loreto (26° 33' N and 111° 51' W; sea level) on Mexico Highway # 1 by a minor dirt road. The site, on a mesa of about 5,000 ha, is at the southern end of Bahia Concepcion.

The stand of cardon at this site is characterized by abundant large individuals (5-15 m tall) that have a low number of side branches per plant (three to six, on average) (Figure 3), differentiating it from most well-branched cardon growing elsewhere in Baja California.

Site Number 4

The village of San Juan de los Planes is the nearest population center. Access to this site is from the paved secondary road that leads from the city of La Paz to San Juan de Los Planes in the District of La Paz (a right turn on a dirt road, before entering San Juan de Los Planes, that runs alongside the village football field; the site begins 3 km down this road [from 23° 56.92' N and 109° 56.58' W, to 23° 54.90' N and 109° 57.43' W, a distance of 5 km).

This site supports large stands of massive cardon, perhaps the biggest in stature in Baja California. In fact, this site may well contain some of the largest cacti in the world. Plants exceeding 10 to 15 m in height, with many massive branches, are very common in this dense stand (Figure 4). Cardon is associated with cholla cactus (*Opuntia cholla* F.A.C. Weber) and mesquite (*Prosopis articulata* [S. Wats] Britt. & Rose) at this site. This is the most threatened of the four proposed conservation sites; there is rapid encroachment from intensive agriculture and cattle ranching. Three large section (over 20 ha each) were clearcut by the local inhabitants as recently as January 1999 (Figure 5).

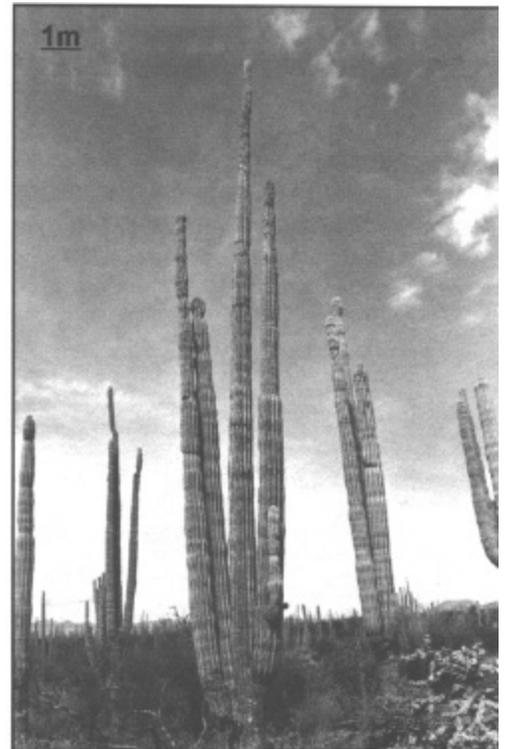


Figure 3. Typical habitat of cardon at Site Number 3.

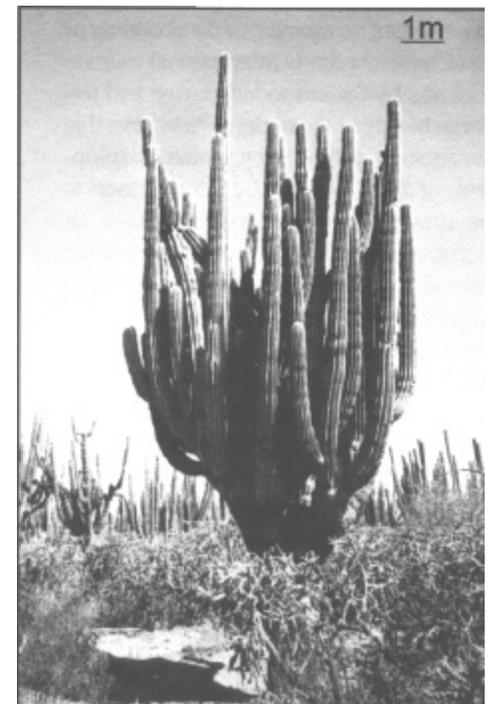


Figure 4. Cardon with low cholla cactus (*Opuntia cholla* F.A.C. Weber) at Site Number 4. These massive specimens of cardon are threatened by clearing.



Figure 5. (A) General view of destruction of cardon stands at Site Number 4 in 1998 and 1999. Arrows indicate fallen giant cardon. (B) Close up of the destruction at the same area.

PROPOSAL SUMMARY

An important component of the economy of Baja California Sur is international tourism promoted by the unspoiled marine and terrestrial beauty of the region. We believe that conservation, followed by limited development, of these proposed cardon conservation sites will provide key ecotourism attractions and additional needed income for the local population. Laws and conservation mechanisms have been legislated in Mexico for protection of biological diversity (Secretaria de Desarrollo Urbano y Ecología 1988), and the Ecological Ministry of the Mexican Federal Government (Secretaria de Medio Ambiente, Recursos Naturales y Pesca) has already declared two large areas of Baja California Sur as natural reserves (Vizcaino Desert and Sierra de La Laguna Mountain Range). Thus, on both economic and legislative bases, we believe that our proposal for the conservation of exemplary stands of cardon in Baja California Sur is a viable one.

In summary, giant cardon is not an endangered species in Baja California Sur. How-

ever, well-developed stands of this plant are not common and should be protected and showcased, as has been done for saguaro cactus (*Carnegiea gigantea* [Engelm] Britt. & Rose) and Joshua tree (*Yucca brevifolia* Engelm.) in Arizona and California (USA), where exemplary stands of these plants are designated as "national monuments."

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