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IN BAJA CALIFORNIA SUR, MEXICO

GINA HOLGUIN, ROY BOWERS, AND YOAV BASHAN

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THE DEGENERATION OF CARDON POPULATIONS IN BAJA CALIFORNIA SUR, MEXICO

GINA HOLGUIN, ROY BOWERS, and YOAV BASHAN*
Department of Microbiology, Division of Experimental Biology,
The Center for Biological Research (CIB),
La Paz, P.O. Box 128, B.C.S., Mexico 23000

The giant cardon cactus (*Pachycereus pringlei*) is one of the most massive cacti in the world and the most characteristic plant in the southern part of Baja California, Mexico. This tree-shaped, columnar cactus normally grows to 15 m tall, with some specimens reaching over 20 m. The cardon can weigh over 25,000 kg, having an enormous trunk of over a meter in diameter and up to 70 ascending branches (Cullmann et al., 1986; Gibson and Nobel, 1986) (Fig. 1). The seeds are larger than those of most other columnar cacti (3-4 mm long and 1-2 mm thick); they are edible, highly nutritious (Valencia et al., 1985) and used to be an important part of the traditional Seri Indian diet in the Sonoran desert of northern Mexico (Felger and Moser, 1974).

The cardon, though known to the western world for hundreds of years, wasn't scientifically studied until the beginning of this century (Cullmann et al., 1986). It has been used in traditional medicine, but very little research has been done on its physiology and biochemistry (Mata and McLaughlin, 1986; Tuttle, 1991; Rose, 1981).

The cardon has a life span of hundreds of years and is the most prominent indigenous plant in the region. Together with other cacti and desert flora, it forms large and dramatic "forests" in this harshest of lands (Fig. 2). Although it annually produces an abundance of viable seeds, seedling establishment under natural conditions is relatively poor. The few seedlings to be found after the first dry season are in shaded, hard-to-reach crevices, where they are concealed from the ravages of desert rodents (Jordan and Nobel, 1981). After the initial year, these survivors protect themselves against further predation by producing various toxic compounds such as alkaloids (Gibson and Nobel, 1986; Mata and McLaughlin, 1980).

Low seedling survival emphasizes the importance of adult plants; if the forest were destroyed by pests or human activity, natural reforestation would be extremely slow. Once full grown, cardon cacti are well adapted to the harsh arid zones, and their extensive root system becomes an excellent top-soil stabilizer. The death of a cardon forest, either natural or man-made, inevitably results in desertification.

Recently, three different types of degeneration

have been observed in some of the cardons of the La Paz region:

(i) Degeneration of Stem Tips. The stem apex of mature cardons starts to discolor, turning gray; later, necrotic tissue appears. The branch stops growing and the degeneration moves down the branch. It is not known whether the entire branch will eventually die as a result of apical die-back (Fig. 3). This phenomenon is not wide-spread.

(ii) Degeneration of Whole Branches. A main branch in an otherwise green cardon dies. Often an apparently healthy young branch will emerge from the base of a dead branch (Fig. 4).

(iii) Death of the Entire Plant, Regardless of Size or Age. In certain areas there is massive degeneration of the entire forest (Fig. 5, arrows). This occurs in young plants, as well as mature



Fig. 1. Healthy cardon in the preserve of the Center for Biological Research (CIB), 20 km east of La Paz, Baja California Sur, Mexico. Note the massive appearance of the plant and its dominance over other vegetation.

* Corresponding author.



Fig. 2. Healthy cardon forest near CIB during the spring of 1991.

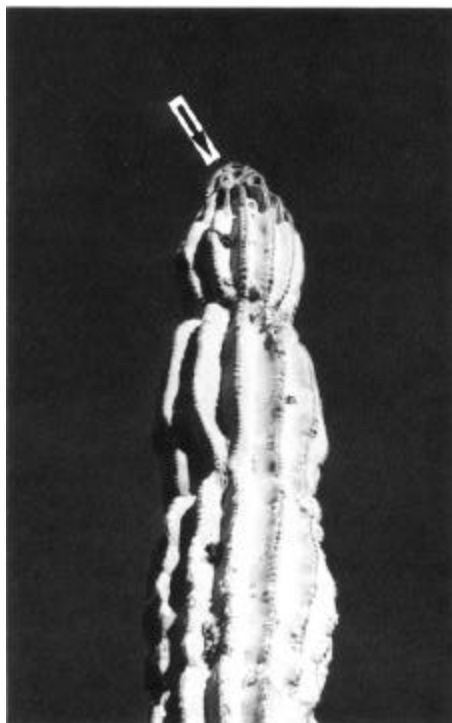


Fig. 3. Death of main stem-tip of the mature cardon (arrow).

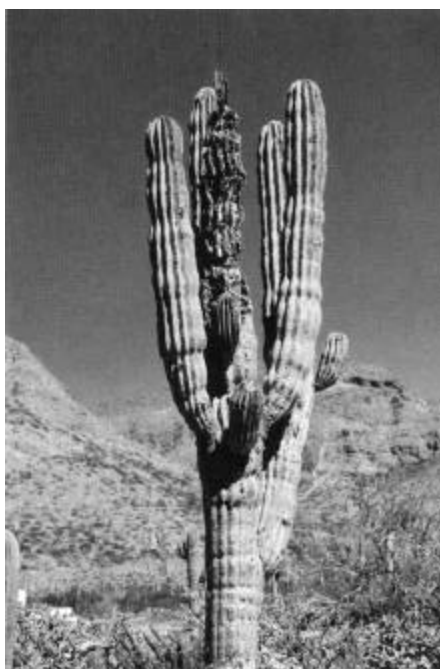


Fig. 4. Death of a branch in a mature cardon.

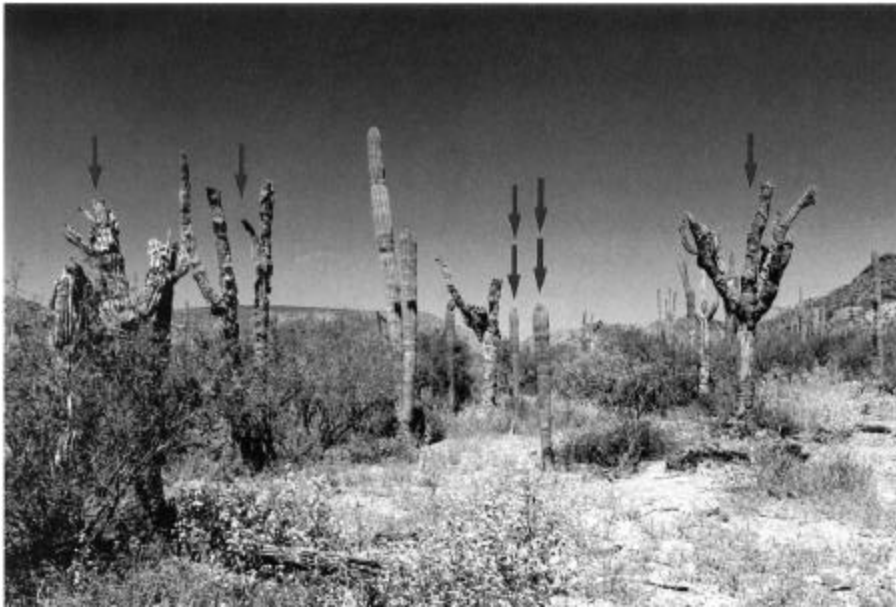


Fig. 5. A degenerated cardon forest. 20 km north of La Paz. Note the complete death of mature cacti (arrows) and the growth of relatively young plants (double arrows).



Fig. 6. Death of a relatively young cardon in a degenerated forest.



Fig. 7. Death of a mature cardon.

and old plants (Figs. 6, 7). Young cardons (smaller than 1 m in height) seldom die and are found growing between the dying ones (Fig. 5; double arrows).

The causal agent(s) of these conditions are unknown. There have been no recent major climatological changes in Baja California. The phenomenon is apparently not caused by man, since the ailing cacti are found in areas far removed from human activity. The possibility of infection from large birds resting on the stem-apices is equally unlikely. Many cardon sites in southern Baja California host large birds where this phenomenon is not observed. Natural death from old age is also improbable since this is not the typical pattern in healthy cardon populations, where only a negligible number of plants die. We suspect the involvement of pathogenic agents. This enigma invites scientific investigation. Without an extensive survey of the severity and possible causal agents, this widespread degeneration of a magnificent species will simply remain an unexplained phenomenon.

Acknowledgments

This study is dedicated to the memory of the late Mr. Avner Bashan of Israel.

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