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Pseudophoenix sargentii: an Endangered Palm Species

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One of the principal problems in tropical countries today is the accelerated destruction of their ecosystems, particularly their tropical forests which are among the most diverse ecosystems of the planet (Raven 1988). The substitution of native vegetation with cultivated fields, pastures for cattle-raising, as well as the development of tourist infrastructures are processes that have increased rapidly during the last 20 years (Toledo 1988). On account of this continuous modification of natural ecosystems, a great number of native species have decreasing populations, to such a degree that many of these are now endangered.

Various authors have tried to estimate the rate of species extinction at the present time (see, Wilson 1988). Without doubt, it is difficult to know how many species disappear from the planet every year. However, it is clear that if the destruction of large areas of forest continues, in a few years, we will lose more than half of the genetic resources on which we rely. Toledo (1988) estimates that Mexico would see its native vegetation reduced to a mere 25% of its original extent in a lapse of only two decades. In addition, we will have lost a great part of our flora with an enormous potential value.

Another important cause of the decrease of populations is the massive and selective exploitation of certain desired species. Numerous species of birds, reptiles and mammals have been pursued for their plumage, skin, meat, or simply for sport. As for plants, many species of cacti, orchids and palms have been overcollected, endangering their survival in their ecosystems.

Undoubtedly, the only way to solve this problem is to stop the process of transformation of these ecosystems and implement different programs of conservation. However, it is of prime importance to have knowledge of some aspects of the biology of the species and of the ecosystems to be able to suggest alternatives of management and conservation. For example, it is necessary to know which are the ecosystems richest in number of species, which are the species in danger of extinction, which are the most sensitive stages of their life cycle, and which are the principal causes that are provoking the decrease of the size of their populations.

In this paper, I describe a demographic study of the palm, *Pseudophoenix sargentii* H. Wendl ex Sarg., with the objective to determine the state of conservation of its populations so as to know what factors affect the different life cycle stages and determine the size of these populations.

The species. Pseudophoenix sargentii is a medium-sized palm with a limited Caribbean distribution. Read (1968) reports that it occurs in the Dominican Republic and Haiti, Cuba, Bahamas, S. Florida, Belize and Mexico. It is precisely in Mexico where its populations reach their major development.

In Mexico, this species grows naturally only in the states of Yucatan and Quintana Roo (Quero 1981). It has a very limited distribution that includes only a few localities, some of which have been totally transformed by tourist and urban development. Besides, for their beauty, adult individuals are extracted from their habitat for commercial purposes as ornamental plants for the main cities of the Yucatan Peninsula.

In spite of its limited distribution, *P. sargentii* may be very abundant in some areas, being the dominant element of the communities at times (Fig. 1). This is an important aspect for the study, because it permits us to count on a large number of individuals for carrying out demographic estimations of all the stages of its life cycle.

P. sargentii is considered to be in danger of extinction on the Yucatan Peninsula by the International Union for Conservation of Nature (IUCN 1988) and by the Secretaria de Desarrollo Urbano y Ecologia of Mexico (SEDUE 1991; SEDESOL

1. *Pseudophoenix sargentii* in the coastal sand dunes of Rio Lagartos, Yucatan, Mexico.

1994), due to the decrease of the plant communities it occupies, the recent tourist development of the region, and its use for ornamental purposes.

Materials and Methods

Study Sites. Three localities were selected on the coastal strip of the Yucatan Peninsula (Fig. 2), all less than 2 km from the coast, but under very different climatic and edaphic conditions (Durán and Franco 1992).

a) The North Coast of the State of Yucatan, in the Special Biosphere Reserve of Rio Lagartos. This is a thicket on coastal dunes on sandy substrate and is exposed to the winds and salt spray from the sea.

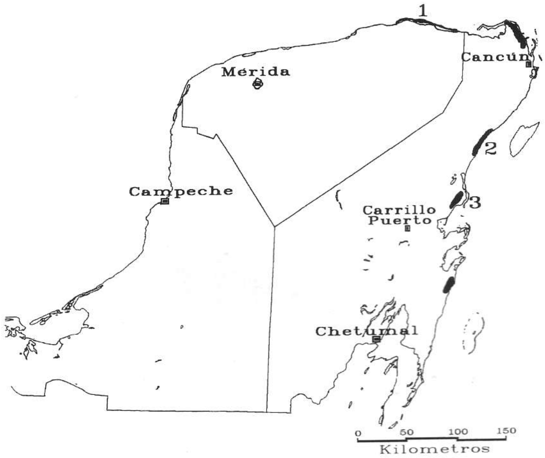
b) A low subdeciduous forest situated near Xel-Ha, in the State of Quintana Roo. The site is protected from the winds, since it is behind the vegetation of the coastal dunes. The palm grows on rocky ground with large solution holes and with little organic material.

c) The Biosphere Reserve of Sian Ka'an in Quintana Roo. This is a community of medium- to low-statured semi-evergreen forest with deeper soils and with more accumulation of organic matter. It occurs in an ecotonal zone between marsh vegetation and a semi-evergreen forest.

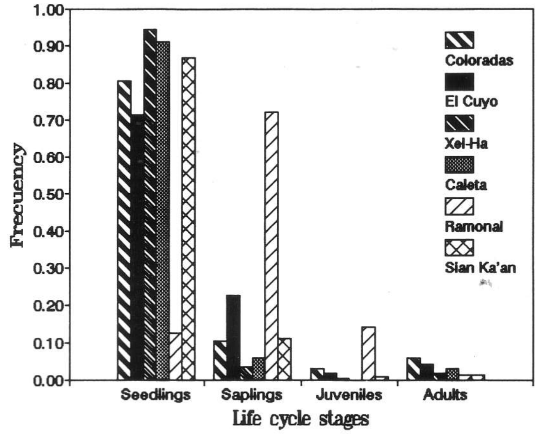
These localities have suffered different levels of human impact; therefore, the status of conservation of each one is very different. In Xel-Ha, there exist various zones where numerous juvenile and adult individuals of *Pseudophoenix* have been extracted for commercial purposes. The same occurs in Rio Lagartos, where a large part of the vegetation of coastal dunes has been disturbed by activities of the salt industry and by the substitution of the native vegetation with coconut plantations. On the other hand, Sian Ka'an has remained practically intact.

Methods. At each locality I chose two populations (El Cuyo and Coloradas in the Reserve Rio Lagartos; Xel-Ha and Caleta in the Park Xel-Ha; Sian Ka'an and Ramonal in the Reserve Sian Ka'an). For each population different plots were selected for sampling, where all of the individuals were marked in order to monitor them for several years.

Beginning in October 1988, and every 3 months thereafter, I censused the populations to determine



2. Distribution of the principal populations of *P. sargentii* in the Yucatan Peninsula. The numbers indicate the study sites: Rio Lagartos (1), Xel-Ha (2) and Sian Ka'an (3).



3. Structure of the populations of *P. sargentii*. The bars correspond at the different studied populations (modified from Durán and Franco 1992).

the growth rate of individuals, their leaf production, their survival, and their fecundity. The number of leaves produced during each interval were counted and marked, the height of each individual was measured to establish growth rates per season and finally the presence of flowers, fruit, and number of inflorescences was registered.

The populations were divided into five phenological classes: seeds, seedlings, saplings (individuals without a defined stem), juveniles (pre-reproductives with a trunk present), and adults (individuals in reproductive age).

With the information generated during two years of observations the growth of the populations was simulated by means of a transition matrix (Lefkovitch 1965). By means of an elasticity analysis (de Kroon et al. 1986), I determined which stages of the life cycle significantly affect the population's growth rate.

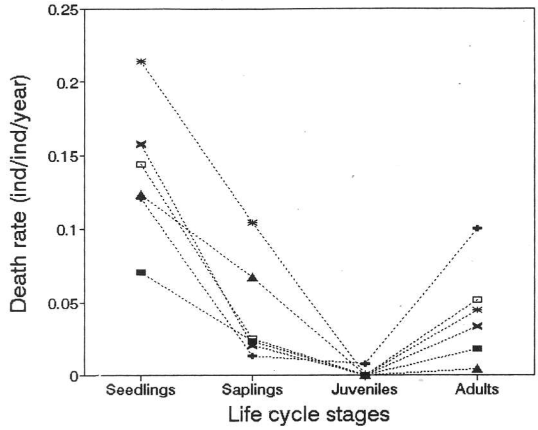
Results

Demographic Characteristics. Figure 3 shows that there is great variability in the structure of the different populations. Five of the six populations present a great number of seedlings, which suggests that good recruitment of new individuals exists in these populations.

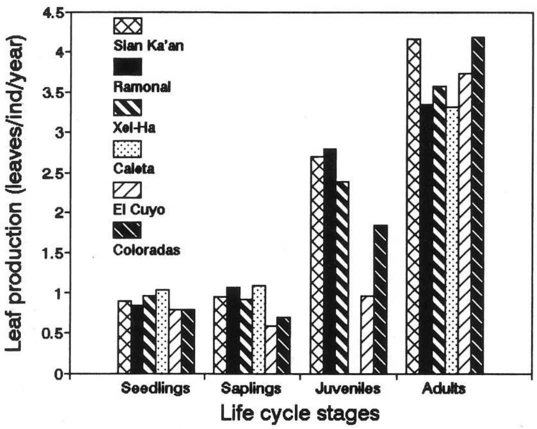
With regard to the mortality of individuals, in general, all the populations show a similar pattern (Fig. 4). However, the mortality of seedlings and saplings was greater in Xel-Ha, while the population of Sian Ka'an presented the lowest mortality for seedlings, and the population of Coloradas the lowest for the adults.

In all the populations, the mortality of juveniles was remarkably low, which suggests survival of the critical period of the first stages. Finally, the adult phase shows an increase in the rate of mortality. This is possibly due to the fact that the oldest and tallest individuals are more exposed to the winds of tropical storms and hurricanes.

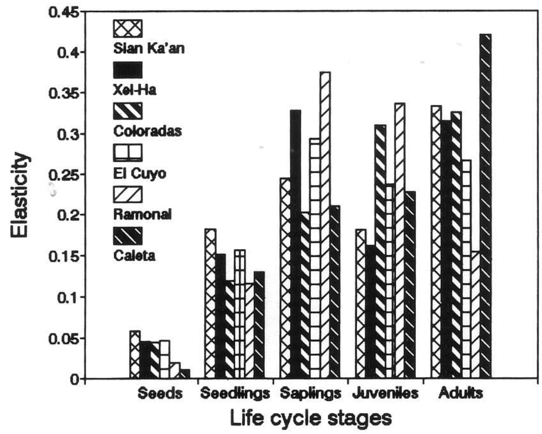
As far as the growth of the individuals is con-



4. Mortality rate of life cycle stages in the six populations. Coloradas (—▲—), El Cuyo (— × —), Xel-Ha (— ∗ —), Caleta (—□—), Ramonal (— + —) and Sian Ka'an (—■—) (modified from Durán 1992).



5. Leaf rate production of life cycle stages in the six studied populations (modified from Durán 1992).



6. Elasticity of the different life cycle stages in the studied populations (modified from Durán and Franco 1992).

cerned, the adult and juvenile stages are phases of fast growth compared with seedling and sapling stages. The leaf production rate increases according to the increase in the height of individuals. In all of the populations, the adult stage presents a higher rate of leaf production than the juvenile stage, and the latter is higher than the rate for sapling and seedling stages (Fig. 5).

It seems that the fecundity of the individuals does not vary between populations. In spite of the existence of a slight tendency towards the individuals of Sian Ka'an having a higher number of seeds per infrutescence than those of Xel-Ha and the latter a higher number than those of Rio Lagartos, statistically there is no significant difference.

It is interesting to note that the structure of the different populations seems to be in agreement with the patterns of mortality and growth that were detected in each one of them during the period of study (Durán 1992). Since the population structure is the result of the phenomena which occurred in previous years, the patterns detected suggest that these phenomena probably have been operating in the same manner during several years.

Populational Behavior. Upon incorporating the information of demographic parameters such as mortality, growth, and fecundity in the transition matrix and simulating the behavior of populations in time, we observe some interesting aspects: all the populations present a growth rate greater than or equal to 1 (Table 1). This signifies that all populations are growing or at least they maintain the size of their populations in equilibrium. It is necessary to point out that this is true only if the calculated population parameters are representative of the average behavior throughout many years.

The elasticity analysis of the life cycle stages shows that, in general terms, the populations of *P. sargentii* are more sensitive to the changes that the older categories experience (Fig. 6). This means that the population growth rate is more affected by the loss of adult and juvenile individuals than the extraction of seeds, seedlings, or sapling individuals.

Table 1. Population growth rate (λ) of the six populations and age of individuals at first reproduction (modified from Durán 1992).

Population	Population Growth Rate (λ)	Age at First Reproduction (years)
Coloradas	1.199	39.83
El Cuyo	1.120	34.65
Xel-Ha	1.083	61.41
Caleta	1.147	55.63
Ramonal	1.000	77.90
Sian Ka'an	1.007	76.89

Discussion

As already mentioned *Pseudophoenix sargentii* is included in the list of Rare and Threatened

Palms of the New World (IUCN 1988), as an endangered species for the Yucatan Peninsula and Florida.

It is necessary to discuss the reliability of these assertions. At first, the level of risk of the species considered in danger of extinction depends in great measure on the distribution and local abundance of these species, and on the factors that affect their habitats as well as the populations themselves. Harper (1981) suggests that the abundance or the rarity of a species has to be considered under a dynamic scheme in space and time.

The fact that a species is included in the Red Data Book of the IUCN or on different lists of specific groups depends on various factors: a) whether there are some researchers who study this species and, therefore, information exists about that species; b) it is influenced by the frame of reference of the researcher, by the level of geographical scale, and by the type of study, which is a product of his own experience (Harper 1981); and c) there is a lack of knowledge about the distribution of the species, and even more, of their local abundance in the localities where it occurs.

In order to resolve this problem, Rabinowitz (1981) proposes to measure the rareness of the species using three parameters: the geographic distribution, the specificity of habitat, and the local abundance of the species. This information, in addition to explaining the causes of its rareness, would permit one to determine a species' susceptibility to extinction.

As has been mentioned, *P. sargentii* is a species whose geographic distribution is limited to the Caribbean Basin (Read 1968). In Mexico, it is located only in the states of Quintana Roo and Yucatan (Quero 1981). Moreover, its distribution in the Yucatan Peninsula is limited to the coastal zone, since it always occurs in places near the sea.

On the other hand, undoubtedly, there exists an accelerated process of transformation of the ecosystems on the Yucatan Peninsula. In particular, in the coastal region, where the populations of *P. sargentii* are found, there has been a continuous growth of the tourist industry, and large areas of native vegetation have been modified. In this context, without doubt, the populations of *P. sargentii* are heavily exposed to human activities, even to the point of being extinguished.

Fortunately, some of these populations are included in the protected natural areas like National Parks and Biosphere Reserves. These can be the refuges that guarantee the permanence of this species, if and only if the activities of rational management and protection of these areas are fulfilled.

Besides, the results of this study indicate that all the populations of *P. sargentii* have a growth rate superior or equal to 1. This supports the idea that the factor that puts the survival of this species at risk is mankind, because in natural conditions the populations would maintain themselves and even increase.

Conclusions

The demographic study shows that without disturbance the populations of *P. sargentii* maintain their size or can even grow. Besides, some of these populations are located in Natural Protected Areas.

P. sargentii grows in few areas, has a restricted geographical distribution, the populations occur in a discontinuous pattern and most of them are small. In an absence of numerical data, it is felt that there is a set of human activities, modifying severely not only the habitat, but through over-collecting, the populations in a direct way.

Life cycle analysis has shown that the harvesting of juvenile and adult individuals has a very strong impact on the growth capacity and recuperation of the populations.

In agreement with this information, it is possible to sustain that due to its restricted distribution and due to the forces that are affecting its populations, *P. sargentii*, in effect, is an endangered species. Because of this, it is necessary to develop some measure of protection that stops or at least diminishes the impact of the forces that affect it. Therefore, it is necessary to modify the ways of utilization of this species, since the actual use consists of the harvest of individuals with a well developed stem.

Acknowledgments

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CHAPTER NEWS AND EVENTS (*Continued from p. 176*)

News from South Florida

The South Florida Chapter of the IPS met on June 21 at Fairchild Tropical Gardens. The meeting featured "Palms for Beginners and Palm Nutrition—A Panel Discussion", with accompanying lecture by Tim Brochat.

On August 16, the meeting focused on "Palms for Experts—A Discussion of Advanced Principles" to help experienced palm enthusiasts improve their palm growing techniques.

A field trip was held on September 16 to Nassau. This was a bus tour featuring many gardens, including the Langlois Estate, % the Bahamas National Trust. Dinner was at a seaside restaurant in the Bahamas.

News from Sydney Branch of PACSOA

The Sydney Branch of PACSOA met on July 18. Featured was a slide show by John Reid on his and his wife Judy's recent trip to China. The usual palm and cycad auction was held after John's presentation.

On Sunday, September 17, the Sydney Branch visited the "Australia in Springtime" Flora Festival at Mt. Penang, Kariong, near Gosford. The group met at the Impact Plants stand conducted by member Paul Anderson.

News from New Zealand

The Palm & Cycad Society of New Zealand met on July 4, 1995, for an informal Wine and Cheese meeting to "chat and be happy". On August 1, the meeting featured Peter Sinclair's presentation of slides from his recent trip to South Africa.

A meeting is planned for October 3 to hear Dick Endt's slide presentation on his recent trip to Bolivia, Argentina, Chile and possibly Peru.

News from the Louisiana Chapter

The Louisiana Chapter of the IPS met on August 20 at "The Palms"—the home of Danny Braud. The meeting featured another tour of the lush tropical garden that Danny has made on his one-acre grounds. He's added several new palm species and a new exotic flower bed since the last meeting there.

The next meeting is scheduled jointly with the Gulf Coast Chapter in October at the home of Maxwell Stewart in Mobile, Alabama. Details not available at press time.

1996 Biennial Meeting in California

Please mark your calendars now for the 1996 Biennial Meeting of the IPS to be held at the Hyatt Newporter Hotel in Newport Beach, CA in August 1996. Official events will be held on August 3–9, with other related events before and after. The meetings in Southern California will be followed by post-Biennial trips to be announced later.

It appears that the post-Biennial tour will be a nice trip to Ecuador starting on Friday, August 9 and probably running ten days/nine nights. The post-Biennial tour will be offered on an all inclusive