



SAHUARO (*CARNEGIEA GIGANTEA*) IN MEXICO

AUTHOR:

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I. BACKGROUND INFORMATION ON THE TAXA

1. BIOLOGICAL DATA

1.1 Scientific and common names

Carnegiea gigantea (Engelmann) Britton & Rose Sahuaro, saguaro, sawaro

1.2 Distribution

The sahuaro (also known as saguaro) is a member of the large cacti group known as columnar cacti. It is distributed in North America over the continental extent of the Sonoran Desert. It is found in sites below 1000 m in the state of Sonora, Mexico, across southern Arizona, and in a very small area near the Colorado River in southern California. At the core of distribution, along the border between Sonora and Arizona, it forms extensive populations that cover thousands of ha. However, in most other areas, it is patchily distributed (Shreve, 1951; Turner *et al.*, 1995; Felger *et al.*, 2001).

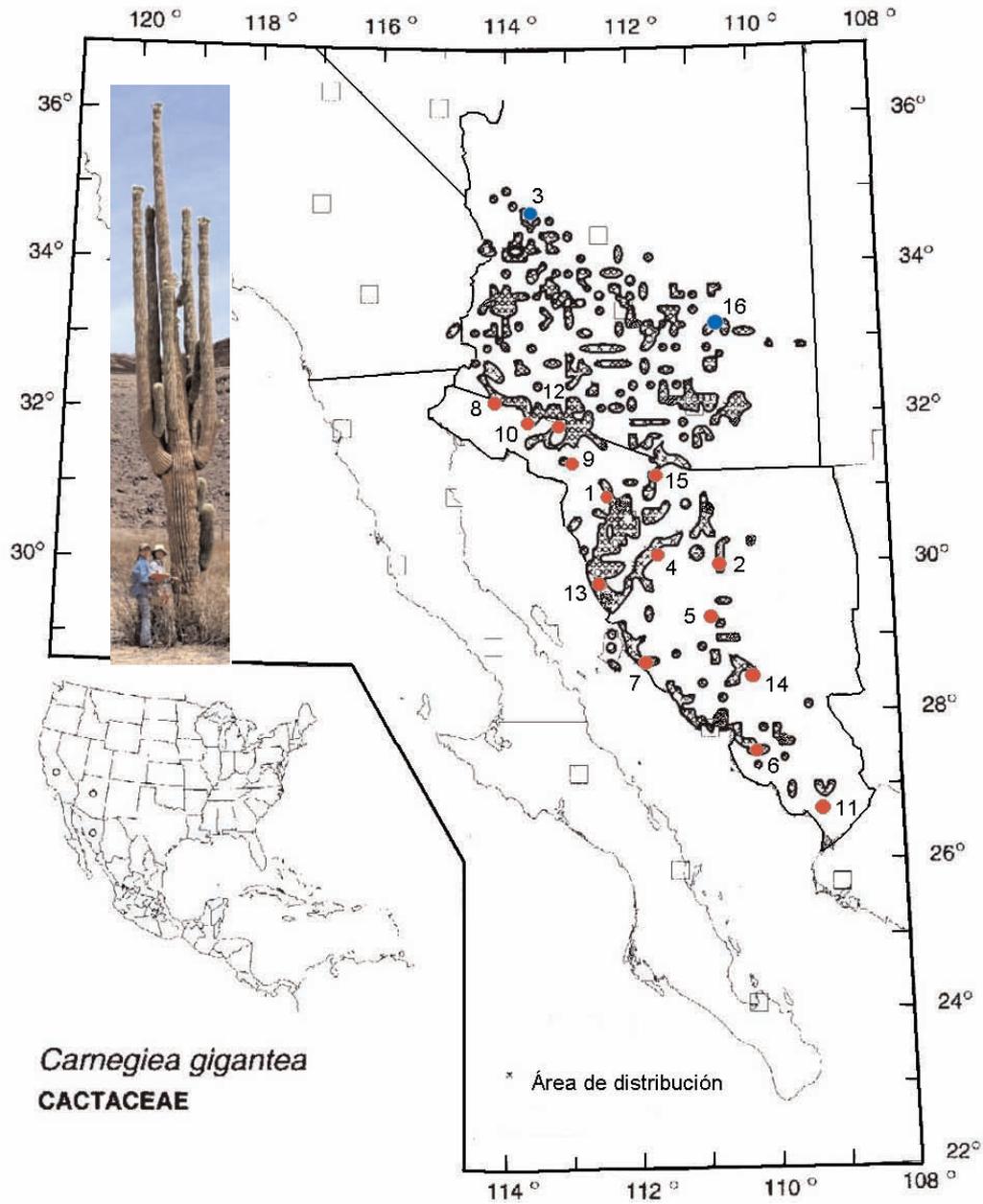
1.3 Biological characteristics

1.3.1 General biological and life history characteristics of the species.

Long-lived perennial, hermaphroditic, leafless crassicaulescent tree
The sahuaro, and emblematic species of northwestern Mexico and the

American southwest, can reach up to 17 m in height and live up to 200 yr. Its main stem can be over 70 cm in diameter. Old individuals can have many lateral shoots. However, sahuaros do not branch until they are taller than 2-3 m, and sometimes they remain monopodial and unbranched all their life. The main stem has between 12-25 furrows or ribs that run longitudinally. Along these, the areolae are distributed. Areolas have 15-30 black, brown or grayish spines, about 2-6 cm long. Large, hermaphrodite, funnellform, green flowers develop at the apex of the stems. They open at dusk exposing a white-creamy corolla and secreting copious nectar. These are pollinated by bats, but some birds and honeybees are known to be able pollinators. The greenish fruits have a red to purplish pulp with several hundreds of small (0.75 mm diameter) black seeds (Shreve, 1951; Turner *et al.*, 1995; Felger *et al.*, 2001). Sahuaro recruitment has been associated to with the presence of some desert perennials, and Steenbergh and Lowe (1969, 1983) proposed the "Nurse Plant Theory" to explain its preferential dispersal and recruitment under the shade of *Parkinsonia microphylla* trees. Recruitment is highly dependent on particular environmental conditions, mainly precipitation, temperature and perhaps some biotic variables. As these occur haphazardly and very infrequently, most populations show skewed size/age distributions (Steenbergh and Lowe, 1969, 1977, 1983; Pierson and Turner, 1998). Large levels of phenotypic variation for many morphological characters are present across its range. It is likely that genetic differentiation plays a role in processes of local adaptation.

Uses: Some individuals are extracted from the wild for ornamental purposes, the extent of this activity is apparently highly localized and of low impact. In Mexico there are no nursery grown sahuaro seedlings for commercial trade. Harvesting of sahuaro "ribs", the woody skeleton of dead sahuaros has been carried out by native peoples for centuries. Desert people, relied on these materials for construction, crafts, and firewood. Today, there is great demand, mainly in the USA markets for sahuaro ribs to make furniture and constructions in the "southwest style". As the species is protected in the USA, most stocks of sahuaro ribs have been imported legal and illegally from Mexico. Cattle ranching, particularly the transformation of desert into pastures of exotic buffel grass (*Pennisetum ciliare*), has extirpated, or severely reduced many local populations contributing to fragmentation (Búrquez y Martínez-Yrizar, 2006; Búrquez *et al.* 1999, 2002).



1.3.2 *Habitat types*

The sahuaro grows in most habitats in the Sonoran Desert. It is bounded in the north and east by freezing temperatures (Turner et al. 1995) Limiting factors in the south are likely to be biological, mainly the shade cast by thornscrub and tropical deciduous forest species that impede its growth. It is known to grow on rocky habitats in the periphery of its distribution and almost all soil types in the centre. The most

common habitats across its range are south-facing slopes. Some areas that seem prime habitat for sahuaro have no populations, while marginal habitats, in some cases have stragglers.

1.3.3 *Role of the species in its ecosystem*

Sahuaro is a prominent species of the desert. In some communities it can attain large population sizes. However, it shows a highly patchy distribution throughout its range. It provides edible fruits designed for bat dispersal that are also consumed by most vertebrates, including humans (Yetman 2007). In high-density populations, the fruits provide a late-spring bounty of resources for many species. Gila woodpeckers carve nesting holes in the sahuaro (McAuliffe and Hendricks, 1988). These nests, last for decades. Later, some of these are used by other species like the elf owl. Little is known about the role of dead sahuaro skeletons. These can stay in the desert for decades while slowly decomposing. A fascinating succession process starts when sahuaros die. It includes microbial communities, fungi, many arthropod species and vertebrates. However, no formal study on the role of dead sahuaros on ecosystem processes has ever been attempted.

1.4 **Population**

1.4.1 *Global Population size*

Population size is large. It amounts millions of individuals. Some populations are healthy and thriving while others are marginal and declining. It is worrying that some of the populations in the southernmost (more tropical), westernmost (close to the Gulf of California), and along the northwestern edge of distribution (along the fringes of the Gran Desierto) are highly fragmented and show small population sizes. Development pressures related to tourism, agriculture and cattle ranching in the south and west are likely to hit sahuaro populations hard.

1.4.2 **Current global population trends**

increasing decreasing stable unknown

1.5 **Conservation status**

1.5.1 *Global conservation status (according to IUCN Red List)*

1.5.2 *National conservation status for the case study country*

None

1.5.3 *Main threats within the case study country*

- No Threats
- Habitat Loss/Degradation (human induced)
- Invasive alien species (directly affecting the species)
- Harvesting [hunting/gathering]
- Accidental mortality (e.g. Bycatch)
- Persecution (e.g. Pest control)
- Pollution (affecting habitat and/or species)
- Other Trampling by cattle _____
- Unknown

2. **SPECIES MANAGEMENT WITHIN THE COUNTRY FOR WHICH CASE STUDY IS BEING PRESENTED**

2.1 **Management measures**

2.1.1 *Management history: None*

2.1.2 *Purpose of the management plan in place: No Management Plans*

2.1.3 *General elements of the management plan*

2.1.4 *Restoration or alleviation measures*
None

2.2 **Monitoring system**

2.2.1 *Methods used to monitor harvest*
None known to the author. Usually harvest occurs without any managing body intervention. Most harvest is illegal. Little, if any, government monitoring of trade has ever been done.

2.2.2 *Confidence in the use of monitoring: None*

2.3 **Legal framework and law enforcement**

There is no legal protection at the national level. It is included as Appendix II CITES species. The USA has recently amended the law. Now it is enforcing the compulsory check of quantity imported with CITES permits. Previously, the permit was presented, but no inspection on amounts was performed.

3. UTILIZATION AND TRADE FOR RANGE STATE FOR WHICH CASE STUDY IS BEING PRESENTED

3.1 Type of use (origin) and destinations (purposes)

Wild sahuaros are heavily used throughout their range. Native cultures, particularly in northwestern Sonora and southern Arizona, use their edible fruits. The wooden ribs are also used locally for many construction purposes, from light fencing to furniture. Trade in live wild specimens is carried in a small scale, mainly for ornamental purposes. These are usually limited to plants 1-3 m tall. Harvest of dead ribs for commercial purposes has increased since the 1990s. A big market for these is present in the southwest states of the USA, and by USA citizens living in México. The demand of ribs has provoked the disappearance of dead individuals in most populations, and it even has led harvesters to illegally cut sahuaros within biological reserves. The price that high quality ribs fetch has led to the deliberate killing of sahuaros for later harvesting. We have gathered strong evidence of extraction of live individuals from several populations.

Although in some populations small harvesting quotas for sahuaro ribs could be granted, in the absence of intensive monitoring and surveillance, we found that it is tempting for harvesters or dealers to deliberately kill sahuaros for later collection. This phenomenon has happened in the past.

3.2 Harvest

3.2.1 *Harvesting regime*

Harvesting of sahuaro ribs is all extractive. Dead sahuaros seem to play a major role in ecosystem dynamics, but no formal study on the extent of the role of dead carcasses has ever been done. Extraction of live sahuaros for their ribs, or for ornamental purposes also occurs and is evidently extractive. Most sahuaros taken alive should be over 6 m tall to yield adequate ribs. The same applies to dead sahuaros. Smaller size-classes produce sub-standard non-market quality ribs.

Harvesting is a non-intensive activity carried out throughout the year, but usually concentrated during the fresh winter and spring months. Many people are involved, but their involvement is brief because the stocks are very limited and sparsely distributed. The harvesting technique is simple: cutting the dead sahuaros with a hack or a chain-saw and carrying them by horse, mule, or car to the nearby ranch where they are sorted and cleaned. Ribs are later collected by a dealer that has the knowledge, and in some cases the political and administrative "clout" to get CITES and forestry permits.

3.2.2 *Harvest management/ control* (quotas, seasons, permits, etc.)

There is no quota system, but Mexican government authorities have established a moratorium on issuing permits until the sustainable use of ribs is clarified. In previous years, large quotas were authorized. The allotments differed in the units used: ribs, cubic meters, weight, etc. Harvesting a hectare of never harvested sahuaro can yield between \$50-\$150 US dls. at present trade value. However, these sites are becoming scarce, and most populations, especially in northern and northwestern Sonora (and many populations outside protected areas within the USA) have been heavily harvested. Being a long-lived plant, its cultivation for harvesting purposes is not feasible. The minimum return time for harvested plants is about 60-80 years.

3.3 **Legal and illegal trade levels**

Historically there are large discrepancies between the issued permits and the exported quantities reported. In one year more than 500,000 ribs were not accounted for by a permit. Nationally, the use is almost restricted to traditional practices. However, there is a trend towards the use of ribs to decorate USA citizen homes in Mexico using sahuaro rib furniture and construction.

II. NON-DETRIMENT FINDING PROCEDURE (NDFs)

1. **IS THE METHODOLOGY USED BASED ON THE IUCN CHECKLIST FOR NDFS? YES NO**

2. **CRITERIA, PARAMETERS AND/OR INDICATORS USED**

Evaluation and modelling through population structure of yield and return times for harvesting dead individuals.

3. **MAIN SOURCES OF DATA, INCLUDING FIELD EVALUATION OR SAMPLING METHODOLOGIES AND ANALYSIS USED**

Field research specifically designed to find if non-detrimental harvest was possible. Modelling and statistical analysis of population survival schedules coupled with allometric constants of growth and population interviews were used. No evaluation of non-detrimental effects were assessed for the removal of dead sahuaro wood, although is recognized as a major element in the ecosystem dynamics of the desert.

4. EVALUATION OF DATA QUANTITY AND QUALITY FOR THE ASSESSMENT

Scientific research that will eventually find its way into peer review publications.

5. MAIN PROBLEMS, CHALLENGES OR DIFFICULTIES FOUND ON THE ELABORATION OF NDF

Extensive distribution, population differentiation, difficulty of access to some sites, secrecy about trading, especially about illegal trading. Recognition that granting the recollection of dead

6. RECOMMENDATIONS

a) Given the sparse distribution of populations, the discontinuous recruitment, the slow growth rate, the minimum size of harvestable individuals, and the important, but not yet scientifically studied, role of dead sahuaro skeletons, it is recommended not to grant export permits of dead sahuaro ribs. Other forms of export that are non-detrimental and can be granted include the export of glasshouse grown individuals from wild produced seeds, or the export of wild fruits and their derivatives. In both cases, the effect of such wild recollection has no apparent detrimental effect on populations, particularly when considering that: i) Only an exceedingly small proportion of the large production of seeds ever enters the population, and ii) Historically the harvest of fruits was probably much higher (probably for hundreds of years) and geographically extensive. In summary, it is not possible to make a positive NDF for ribs, but it is possible to do so for trade based on the harvest of wild seeds and fruits, including their derivatives.

b) More studies to elucidate growth rates on populations throughout the distribution range are needed, mainly to calibrate the relationships between size and age of the individuals.

c) More research to determine the extent of genetic differentiation between populations is needed. That will allow grading the effect of harvesting across the whole distribution range, or if populations can be assigned to certain biotypes, to assess the most imperilled populations.

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