

# Ecology and Management of the Chilean Palm (*Jubaea chilensis*): History, Current Situation and Perspectives

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The Chilean palm, *Jubaea chilensis* (Front Cover), one of the most emblematic tree species of the Chilean flora, has suffered a gradual reduction of its population numbers in the last 150 years, with the estimated 120,000 palms that exist today being no more than 2.5% of the existing population found at the beginning of the 19<sup>th</sup> Century. From an economic point of view, this plant has been one of the most prized species in the central zone of Chile due to its two valuable products – its sap, the basis of the traditional palm honey industry, and its seeds (mini-coconuts), which are also an important product for the food industry. Along with a history of extensive use, there has been a drastic reduction of the accompanying native vegetation due to anthropogenic activities, thus reducing the appropriate habitats for the natural regeneration of this species. Given its current ecological condition and the need to implement strategies that ensure its conservation, it is necessary to evaluate current knowledge of the palm. This article gives a general background of the species, i.e. biogeography, ecology and history of use, and general recommendations are provided to ensure its persistence in the central zone of Chile.

In Chile, the palm family is represented by two monotypic genera: *Jubaea* and *Juania*; *Jubaea chilensis* (Molina) Baill. (Chilean palm) is distributed in the central area of the country, and *Juania australis* (chonta) is found exclusively in the Juan Fernández archipelago (Muñoz 1962, Gay 1853).

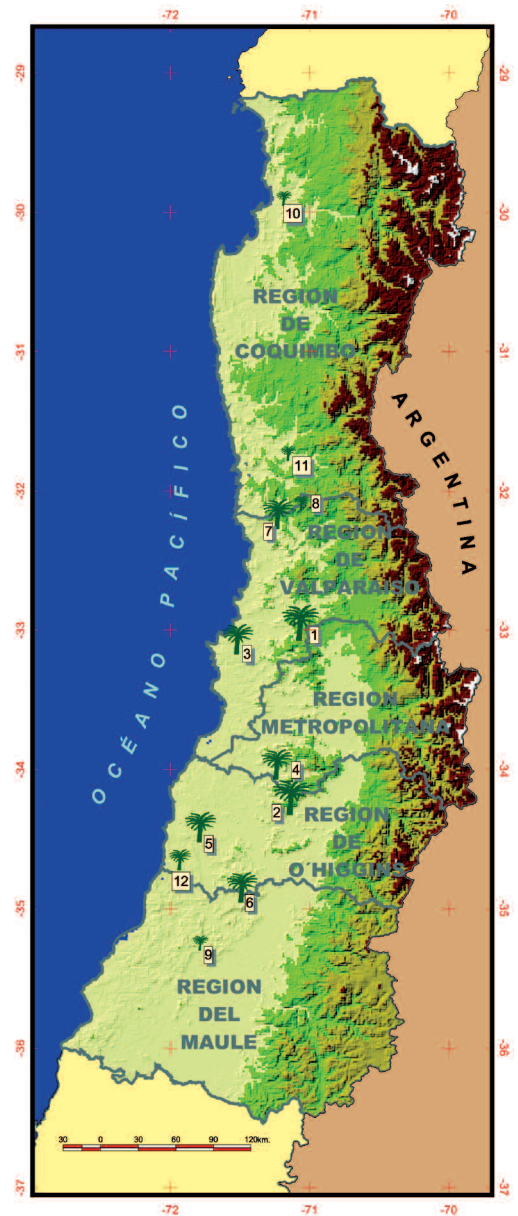
The history of *Jubaea chilensis* is linked to the geological history of South America. Successive global climate changes along with the Andean orogenesis resulted in the confinement of tropical elements to the western slope of this mountainous range (Villagrán & Hinojosa 2005). As a consequence of these geological changes, a particular floral composition of the Mediterranean zone has emerged with coexisting elements such as those with austral-antarctic and tropical origins.

The current geographic distribution of the Chilean palm is very restricted, confined to an area from the south of the Limari river (IV Region) to the surrounding areas of Curicó (VII Region), always along the Coastal Range of Chile. Serra et al. (1986) point out that it is difficult to specify geographic limits since the populations of this species have been strongly fragmented by the action of man (Bordeau 1992).

The northernmost limit is in the Hacienda Las Palmas, IV Region (31°15'S, 71°35'W), whilst its southernmost limit is the locality of Tapihue, VII Region (35°22'S, 71°47'W) (Fig. 1). Nowadays, there are around 15 localities where we may find the Chilean palm (Tab.1); however, in only three localities are the population numbers important: Ocoa (aprox. 60,000 individuals), Cocalán (35,000 individuals) and Las 7 Hermanas (7,000 individuals), thus representing more than 90% of the total (Serra et al. 1986, Rundel & Weisser 1975, Michea 1988).

In spite of the interest generated by *J. chilensis* in our country, scientific knowledge of this species in key aspects of its biology, such as reproduction, population regeneration or the biological interactions in which it is involved (pollination, frugivory and herbivory), are surprisingly scarce. Nothing is known about the population genetics of this species or of its reproduction systems. This lack of information is serious since this knowledge is essential to elucidate how to assure the persistence of this species under natural conditions.

The indiscriminate harvest of seeds (mini-coconuts), which in many populations results



1. Geographical distribution of Chilean Palm.

in the extraction of the total nut production, has been identified as the main cause of the reduction of the population numbers (Serra et al. 1986). In fact, the large majority of remaining populations are dominated by senescent individuals with a low or null proportion of juveniles (Michea 1988), suggesting that the major limitations of the recruitment of new individuals occurs in the early stages of the life cycle (Marcelo 2007).

The conditions for successful seed germination are well known under nursery settings (Infante

1989, Arrué 2000, Solari 2002), suggesting that the species has no serious physiological constraints for germination. There is only one study (Serra et al. 1986) that suggests that germination and subsequent survival of the seedlings are strongly dependent on the plant cover of the sclerophyllous forest, since the regeneration of new individuals in bare soil is non-existent. Recent field experiments support the existence of this nurse effect (Marcelo 2007). On the other hand, the seeds of the Chilean palm are actively consumed by native (e.g., *Octodon degus*; Zunino et al. 1992, Yates et al. 1994) and introduced rodents, an important mortality factor that requires evaluation. Also, seedlings are actively consumed by exotic rabbits, which is thus an additional limitation for regeneration (Marcelo 2007).

Once individual palms surmount the ecological barriers imposed on seeds and seedlings, no further mortality factors (excepting the death of individuals for human

use) are critical for the juveniles and adult plants. Once the trunk is formed (at 25–30 years of age), the Chilean palm presents a notable resistance to fire. In fact, the mortality of adult specimens as a result of fire is almost zero even though the current occurrence of fires in Central Chile is extremely high (Montenegro et al. 2004)

### Conservation and Management

Given the disappearance of the Chilean palm in vast areas of Central Chile, the authorities tried to protect the species inside Protected Wildlife Areas 35 years ago. These efforts resulted in the protection of the largest population in the area of Ocoa of the Campana National Park (Fig. 2). The population of Cocalán, the second in size, has remained in private ownership, and although this area was also declared a National Park, this situation has not been resolved legally.

The Chilean palm has occupied a very significant role in rural culture. The extraction

**Tab. 1. Natural Populations of Chilean Palm. Estimates were based on known inventories, published data and the authors' observations.**

	LOCALITIES	Long.	Lat.	No. of palms (estimated)
1.	Sector OCOA: including "Parque La Campana, Hacienda Las Palmas de Ocoa, Oasis La Campana y Palmas de Vichiculén-Llay Llay"	32°57'	71°04'	70,308
2.	Sector COCALÁN: including "Hacienda Las Palmas de Cocalán, La Palmería", and surrounding areas.	34°12'	71°08'	35,500
3.	Sector VIÑA DEL MAR-VALPARAISO: including "Las Siete Hermanas, Subida Santos Ossa" and surrounding areas.	33°04'	71°31'	7,200
4.	"Cuesta Los Guindos- Cuesta Alhué".	33°58'	71°14'	2,500
5.	"San Miguel de Las Palmas".	34°25'	71°47'	2,000
6.	"La Candelaria".	34°51'	71°29'	1,900
7.	"Tunel de Las Palmas, Pedegua".	32°09'	71°09'	1,300
8.	"Tilama, Pichidanguí".	32°05'	71°08'	50
9.	"Tapihue, Pencahue".	35°15'	71°14'	17
10.	"La Serena".	29°54'	71°15°	3
11.	"Limahuida, Los Vilos".	31°44'	71°09'	2
12.	"Paredones, El Asiento, Talamí", and dispersed individuals			200
	TOTAL			120,980

of palm sap, the basis for the production of palm honey, constitutes a traditional activity which has maintained the same characteristics for more than 200 years. Traditionally, sap harvest has resulted in the sacrifice of the specimens. Once the individuals are uprooted, their apex is cleared, and the exudation occurs through the apical meristem. The sap harvest takes a whole summer season, and approximately 400 liters of sap are obtained per specimen giving an average of 90 kg of sugar concentrate. This concentrate is stored for aging and to increase its yield in the manufacture of the industrial product, which also contains sucrose, sap and water. With a concentrate aged for 20 years, the volume of palm honey obtained may be more than 20 times the concentrate volume.

In the exploitation of the palms for the production of honey, it is necessary to distinguish two different types, each one with a different spatial as well as temporal effect: home-made honey production, the more traditional way of extraction, and the industrial production, currently carried out by the private enterprise Cocalan Palm Honey Ltda. at Cocalán. The production of home-made honey was without doubt very

important in the past. This form of exploitation, which resulted in massive extractions of plants (Vicuña Mackenna 1877) has been traditionally ignored in terms of the negative ecological impact on the species and on the entire ecosystem. However, it was an important activity for a very long time and especially during some periods in which there was a shortage of other types of sugars required for human consumption. It is quite possible that requirement for the palm sap may have been extremely strong in the past, particularly in areas of Central Chile with a large number of rural population concentrated due to seasonal agricultural activities.

The exploitation of the sap at an industrial level has had a continuous development since 1878 only in the localities of Ocoa and Cocalán. This industrial exploitation seemed not to affect natural populations negatively, since it is precisely in these localities where the major populations are found at the present day. Furthermore, both of these localities always had controls on the access of illegal exploitation. In 1980, more rigorous controls were established through Management Plans supervised by the National Forest Corporation (CONAF) and the Agriculture and Livestock

## 2. Typical population structure of Chilean palm in areas oriented to the production of fruits.



Service (SAG). In Cocalán, the average extraction of individuals did not exceed 30 specimens per year, a number by far sufficient to satisfy the demand for palm honey in the national market. In fact, this population is the only one that presents a population structure with a greater proportion of young individuals with respect to older ones, a pattern that strongly suggests good regeneration and largely contrasts with the population structure observed in other localities where adult individuals are largely dominant (Fig. 3).

### Threats to the conservation of the Chilean Palm

We can identify two human activities that are consistently pushing this species to an extinction vortex: the harvest of nuts and the reduction of native vegetation.

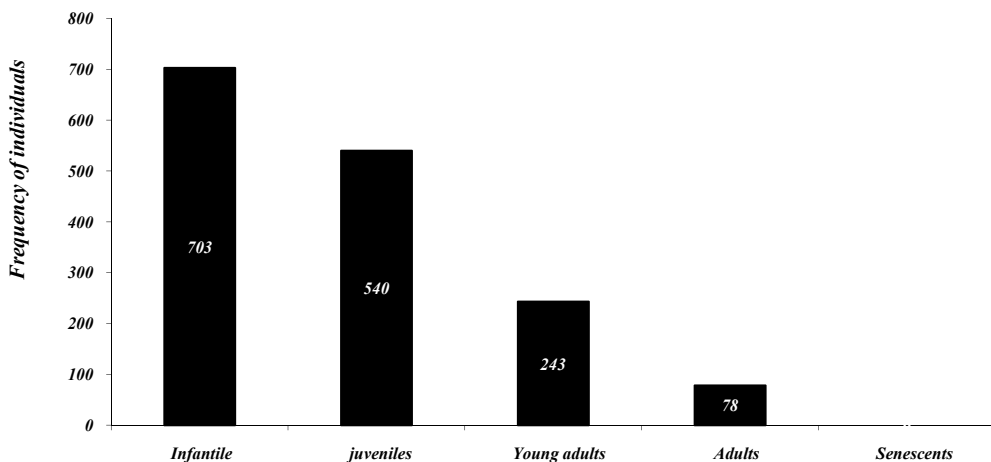
**Harvest of young nuts:** There is no doubt that the Chilean palm has an abundant seed production and although its germination is difficult, there should be no problem in terms of its self-propagation. However, the great demand for seeds for human consumption allows us to assume that the uncontrolled fruit harvest has probably been the most important cause of its disappearance in certain areas. In fact, this activity, of which specific details are unknown, is carried out in almost all the existing palm populations with the exception of Cocalán, where there has been a certain control on behalf of the company. In Ocoa, the fruit harvest control ceased in 1970 when the lands came under the administration of the Campana National Park. The administrators

of the park have established a protocol to regulate the activity, which includes the park, seed collectors and the private company "Oasis La Campana." This company sells to collectors a proportion of nuts in order to produce large numbers of seedlings for ornamental purposes. The rest of the seeds are presumably returned to the park for natural regeneration. In other palm populations there exists no control of nut extraction, and the entire seed crop is harvested by people.

Although the harvest of nuts is regarded as the main threat to the long-term persistence of the palm, currently there is no information on the total production of seeds per individual, population or species; there is no information on the total number of seeds extracted for human use, and if the nut production of palms in inaccessible places (not consumed by people) is enough to assure the necessities of native rodents, which use these resources during winter. The knowledge of these numbers will be crucial to manage this resource in a sustainable manner and also to elucidate if this extraction is affecting other levels of the food web.

**Reduction of the vegetation cover:** As of the second half of the 19<sup>th</sup> Century, following the discovery of gold in California and Australia (from 1848 to 1852), there was a massive change of land use in Central Chile. Large amounts of forested areas were eliminated with the purpose of producing wheat. This land use change resulted in a drastic reduction of the sclerophyllous forest, the dominant native vegetation of Central Chile. The reduction of

3. Typical population structure of Chilean palm in areas where they are devoted to sap production .



the cover of native vegetation resulted in reduction of the microhabitats that favored seed and seedling survival of the Chilean palm. Unfortunately, unlike other native trees, such as *boldo* (*Peumus boldus*), *peumo* (*Cryptocarya alba*), *litre* (*Lithraea caustica*) and *quillaja* (*Quillaja saponaria*), this palm does not regenerate vegetatively. In summary, the elimination of the sclerophyllous forest for agriculture and forestry has been a serious cause of the disappearance and/or reduction of the numbers of the Chilean palms particularly in Central Chile, because of constraints to natural regeneration. The conservation of the sclerophyllous forest certainly will help the conservation of the Chilean palm.

### The Chilean Palm: proposals for sustainable management

Although the importance of this species as a valuable natural resource has been largely recognized, isolated initiatives began only during the 1970s. The first study that examined the potential of the Chilean palm as a resource was an undergraduate thesis at the University of Chile entitled "Inventory and production study of the Chilean palm, *Jubaea chilensis* (Mol.) Baillon., Hacienda Ocoa, Valparaiso" (Rubinstein 1969). This pioneer investigation received limited attention. This is unfortunate as from this study emerged important recommendations. Specifically, the author concluded that because of (i) the high productive potential of *Jubaea chilensis*, based not only on the production of honey but on the products derived from the fruit and leaves and (ii) the real potential of this species for reforestation and recovery in arid and semi-arid ecosystems, it provides a good opportunity for an economically sustainable activity, which at the same time provides social benefits as it may constitute a source of employment in a region where the cost of owning land is high and the large labor force is poor.

More sustainable initiatives other than nut harvest and sap extraction are still in initial stages in Chile. In the cities, it is used as an ornamental plant thus replacing the exotic palm *Phoenix canariensis* currently found in parks and avenues. Until a few years ago there were no nurseries dedicated to the production of seedlings and saplings of *Jubaea chilensis*. Only in recent years has this enterprise begun, but the availability of plants is still low, and the prices are high. Additionally, there is no study that assures an acceptable level of survival in a massive plantation. Currently,

the Hacienda Las Palmas de Cocalán is the only place in the world where there is an integrated sustainable productive management of a natural forest of Chilean palm under the supervision of public agencies (CONAF, SAG). This activity that begun in 1982 has been concentrated on the extraction of the sap to produce honey, extracting about 30–34 individuals per year. More recently, other initiatives have been conducted in other localities to commercialize young and adult palms for ornamental purposes as well; this is the case of the Oasis La Campana S.A., situated close to La Campana National Park, and the nursery of the Agrícola Santuario Las Palmas Company adjacent to the Las Palmas de Cocalán.

Although a lot of experience has been accumulated in recent years using the Chilean palm as a sustainable resource, it is still unavailable to owners of small farms with dry and poor-nutrient soils inadequate for most agriculture but very suitable for the culture of the Chilean palm. We suggest that the culture and economic use of the Chilean palm is viable for these people. First, palm culture does not require great extensions of land, and young plants do not require special care for survival and growth. In fact, some experience shows that specimens growing without fertilizers, pesticides or irrigation have shown a development that allows 40–45 year rotations for sap production and nut production. Secondly, there exists the basic knowledge to improve germination and survival of seedlings and saplings under controlled conditions. Thirdly, small farmers do not have so many other economic options, so these initiatives may become a unique opportunity improve their quality of life.

A plantation for the purposes of producing sap for the manufacture of palm honey is perfectly compatible with the culture of young and juvenile plants (5–15-year olds) for ornamental purposes. The demand for this type of product is increasing very fast, and prices are attractive for export. Moreover, preliminary results suggest that the palm honey may be extracted without killing individuals, such as occurs in the Canary Islands with *Phoenix canariensis*. In this case, the production takes place during a period of 4 to 9 months with an average of 8 to 15 liters per day, depending on individual variation (Mesa Noda 2001). From our experience, individuals may be "milked" every five years with no further problems of survival and growth.

## Conclusion

The Chilean forestry activities have been sustained almost exclusively by exotic plants of rapid growth, such as *Pinus radiata* and species of the genus *Eucalyptus*. Currently, there is a need for a focused promotion towards the sustainable management of native forest and at the same time towards the diversification of species used in forestry. A project based on the Chilean palm is evidently outlined within the policy of a native species which occupies a territory that has no alternative use. Furthermore, it constitutes a genuine intent to recover an emblematic native species such as our Chilean palms for conservation and management.

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