Palm Trees, Mana, and the Moving of the Moai

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In his description of Easter Island, Captain James Cook (1777) reports, ". . . the country appeared quite barren and without wood," and the naturalist G. Forster noted, ". . . there was not a tree upon the island which exceeded the height of ten feet". That was in 1774, and even today the only large trees to be found have been introduced—primarily eucalyptus and a few dozen coconut palms brought in from Tahiti.

Following the initial work of Selling (1948), Flenley and King (1984) took core samplings from the sediments of four different crater lakes--Rano Raraku, Rano Kau, Rano Aroi and Pu Katiki--and found substantial quantities of pollen, a great part of which was identified as originating from palms. Later, John Dransfield et al. (1984) pointed out the similarity between the collected pollen and that of *Jubaea chilensis*, the indigenous palm of mainland Chile used principally in the productions of "*miel de palma*", a sweet syrup widely consumed in Chile in desserts. Dransfield (personal communication, 1993) has cautioned, however, that this similarity of pollen does not imply a similarity of palms.

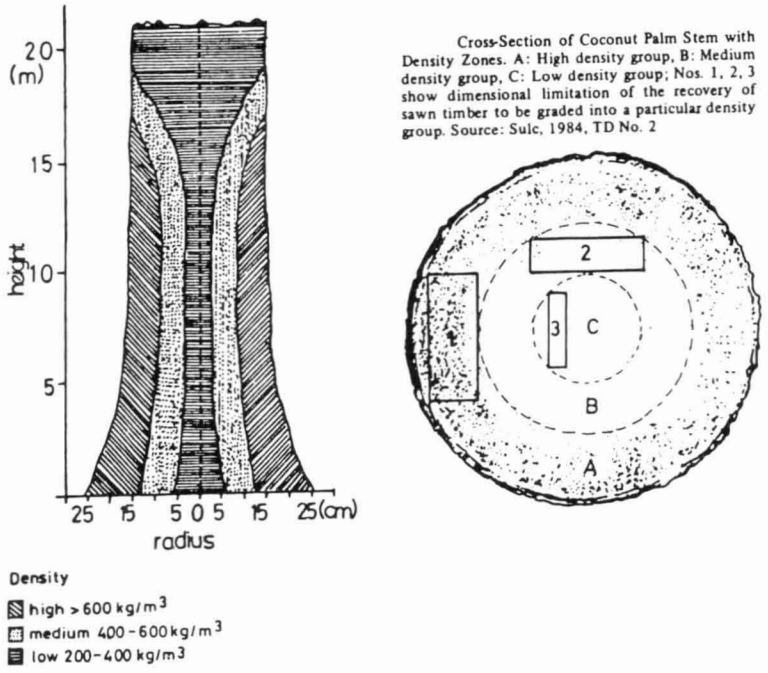


Figure 1. Schematic density distribution in a mature coconut palm stem (from Killman 1988).

Pacific Ocean currents of the south tropical zone flow primarily from east to west, making it quite conceivable that some of the small coconuts of *J. chilensis* have floated westward in the past to Easter Island ultimately establishing themselves on that isolated island roughly 2200 km to the west of the continent. Experiments with the nuts of the coconut palm, *Cocos nucifera L.*, have shown that they can remain viable for several months floating in salt water. Similar experiments should be carried out with the fruit of *J. chilensis*. The Kon-Tiki required, after all, three months to drift from the continental shores of Peru to the Tuomotuan Islands.

And so the question remains, what were the characteristics of the once-abundant but now extinct Easter Island palm now named *Paschalococos disperta* J. Dransfield ? (see Zizka (1992). Specifically, could the trunks of this palm have been used as rollers or sleds to transport the *moai* from the quarry at Rano Raraku to distant points on the island? What other uses did *P. disperta* provide and what nutritional value did its fruit and sap have?

Since these questions cannot be answered by direct experimentation, we can only examine the characteristics of similar plants. In the following paragraphs we will summarize some of the physical properties of the two above-mentioned palms, *Cocos nucifera L.* and *Jubaea chilensis,* hoping that in the near future, further evidence will surface giving us a better idea of what *P. disperta* was actually like.

Note that although the terms coconut "trees" and coconut "wood" are, strictly speaking, inappropriate, they have common usage and will be used here.

Cocos nucifera L., the ubiquitous coconut palm well-known to Pacific island travelers, produces large nuts from which copra, the dried kernel, once had considerable economical value, mainly for its oil which "becomes the base for a wide range of products, from cooking oil to soap and shoe polish" (Killmann 1988). Of course the fresh meat is till valued as a tasty food, high in calories--and cholesterol. Furthermore, the palm leaves and fibers are used to make roofs, ropes, baskets and clothes. Even an alcoholic beverage can be brewed by fermenting and distilling the inflorescence, and of course, the husks and nuts are frequently dried and used as fuel.

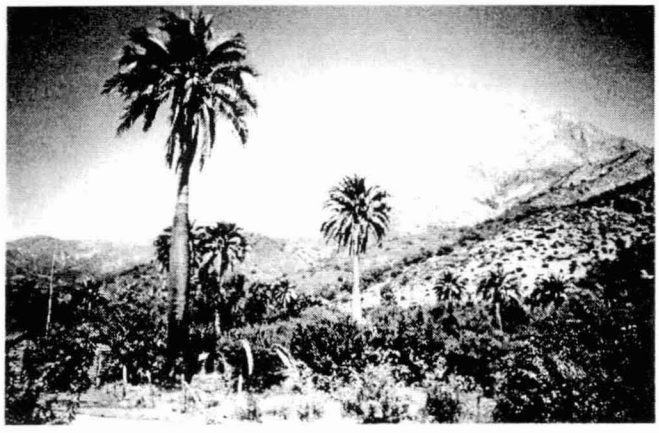
But what of the wood of the stem itself? According to Killmann (1988), when palms are over 60 years old, the copra yield declines, and the wood becomes of interest to the builder. A 60-year-old palm will have, on the average, a stem varying in diameter from 15 to 30 cm and a height of about 20 meters. The outer section of the lower part of the stem has minimum density of 600 kg/m^3, similar to familiar hardwoods such as oak, walnut, maple and ash. The inner parts are correspondingly less dense as Figure 1 shows. The densities of 200 to 600 kg/m^3 are comparable to that of white pine (350 to 500) and cedar (490 to 570). According to tests on coconut palms in the Philippines (Sulc 1983), compression strengths perpendicular to the grain range from 57 down to 15 megapascals with the modulus of rupture about double those values. (A pascal is a measure of stress--an acceleration of 1 kilogram/second/second per square millimeter.)

At the Malaysian German Forestry Research project, Killmann and colleagues are showing how palm wood can be used structurally, and have demonstrated its effective use in building houses and furniture, and even baseball and cricket bats and artificial limbs.

Clearly, if Easter Island were once covered with coconut palms, the Rapanui natives would have found these trees immensely useful. It would be difficult to design a better roller than the lower part of a mature palm trunk since the cylindrical form of the outer hardwood would support an estimated six tons before yielding, while the softer interior wood would provide a resilient inner spring.

tency to that of the familiar supermarket coconuts. The nuts can occasionally be found for sale in early autumn. To what extent the sap was used and processed can only be guessed, but an isolated island civilization hard pressed for food and water would surely have discovered its potential.

To our knowledge, nothing has been published about the structural properties of the wood *of J. chilensis*. Consequently,



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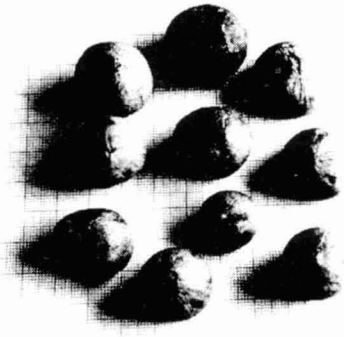

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Figure 2. *Jubaea chilensis*, four different aspects: A) growing wild in a Chilean National Park; B) exposed tree roots; C) a cut-away of the interior of a mature stem; and D) *coquitos* on millimeter-scale paper.

Jubaea chilensis, believed to have been much more abundant in Chile, has now been registered as an endangered species, protected by CONAF, the National Forestry Corporation (Figure 2 and Michea 1992). Dr Juan Grau (1996) has summarized very well other properties of *J. chilensis* . Unfortunately, the main commercial use of this magnificent palm results in it being cut down--to remove the sap which is later processed into syrup. According to elder Chileans, the syrup sold today is a weak and watered down infusion compared to what it once was. From the standpoint of conservation, it is difficult to say whether this is good news or bad, but it probably reflects the trees' increasing scarcity.

However, it is clear that had *J. chilensis* once flourished on Easter Island, its fruit and sap would have proved immensely useful. Compared to *Cocos nucifera*, the nuts are small--as we know the nuts of the *Paschalococos disperta* were. (A few rat-gnawed specimens have been found in island caves. See Figure 2 in Dransfield et al., 1984). However, the meat and liquid inside are quite similar in taste and consis-

one of us (WL) went with two US Park Rangers to the Chilean National Park, Las Campanas, where a major stand of the palm is to be found in a protected environment. There we were permitted to collect fallen nuts (mostly vermin-gnawed) and to take wood samples from two fallen trees, both obviously mature when they blew down in storms.

It should be noted that a mature *J. chilensis* reaches a height of about 30 meters and a maximum diameter of over a meter. It is a mighty tree, called by Digby Neave (personal communication, 1991) "the king of the tribe."

We have found that the inner cambium is rather different than that of the coconut palm: less dense but more fibrous. The schematic density distribution is shown in Figure 2, with densities varying from 210 to 540 kg/m^3. But it should be noted that these values are from two trees that have been dead for three and for 20 years, according to local informants.

However, it is the tough outer bark, or pericarp, that is remarkable. Averaging 5 millimeters thick, it is unusually dense, varying from 1300 to 1640 kg/m^3 making it similar to

materials such as bone and ivory, denser even than *lignum vitae* or ironwood. A boat or canoe made of this outer shell would stand much physical abuse.

In summary, a roller made from the trunk of *J. chilensis* would be much like a hardwood barrel with a solid softwood interior. The outer shell would be made of wood much harder than oak, for example, and inside the softwood would be of a density comparable to that of white pine. It, too, would be able to support several tons of weight. In an on-the-spot test, four adults standing closely together jostling up and down made no impression on the horizontal palm trunk.

It should be mentioned that the *coquitos*, or coconuts of the Chilean palm found in the national park were, on the average, larger in equatorial diameter than those found in Kew Gardens and measured by Dransfield et al. (1984) —23.1 mm as compared to 21.7 mm —and therefore closer to that found for the Easter Island palm, namely 28.4 mm.

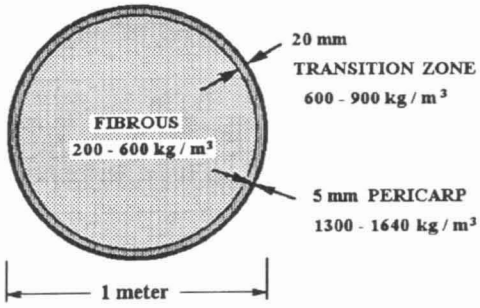

Figure 3. Schematic density distribution in a mature *Jubaea chilensis*.

Finally, some comments on the mechanics of moving the *moai*. As Charles Love has demonstrated, a large *moai* could be moved vertically on rollers, thereby fulfilling the mythical requirement that through the magical, mystical powers of *mana*, the *moai* "walked" from Rano Raraku to their intended altars. Nevertheless, placing the *moai* horizontal would have been a far safer means of moving and would have made possible a more efficient use of a large number of rollers.

In the early days of *moai* carving, the nearest palms would have been cut down, and the stems dragged to the quarry. However, as time passed, the *moai* movers would have had to go farther afield to find suitable palms. Gradually, a circular denuded area would have grown outward from Rano Raraku. It has been suggested that the nearby but now-barren Poike peninsula was once covered with trees--a number of root molds have reportedly been found in the soil--and given its elevation above that of the land surrounding Rano Raraku, Poike might have been a favorite place to harvest palms since the stems could then have been conveniently rolled down the hill to the quarry.

Finally, it should be pointed out that the basalt or obsidian ax-heads that were used to fell the palms should be found in greatest abundance near where the palms were cut. A careful inventory of the distribution of recovered ax-heads might, therefore, indicate where the palms were cut. However, an ax suitable for cutting down a tree is likewise suitable for killing an enemy, so we caution that there may have been considerable redistribution of sharp or otherwise useful tools following the initiation of the tribal wars.

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