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Heyne, Catherine

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Lab Copy

**Identifying Prehispanic Wood from Archaeological Contexts
in Andean Argentina**

A Senior Thesis Submitted by

Catherine Heyne

In partial fulfillment of the requirements
for a Bachelor of Arts degree

1992

Lab Report # 30

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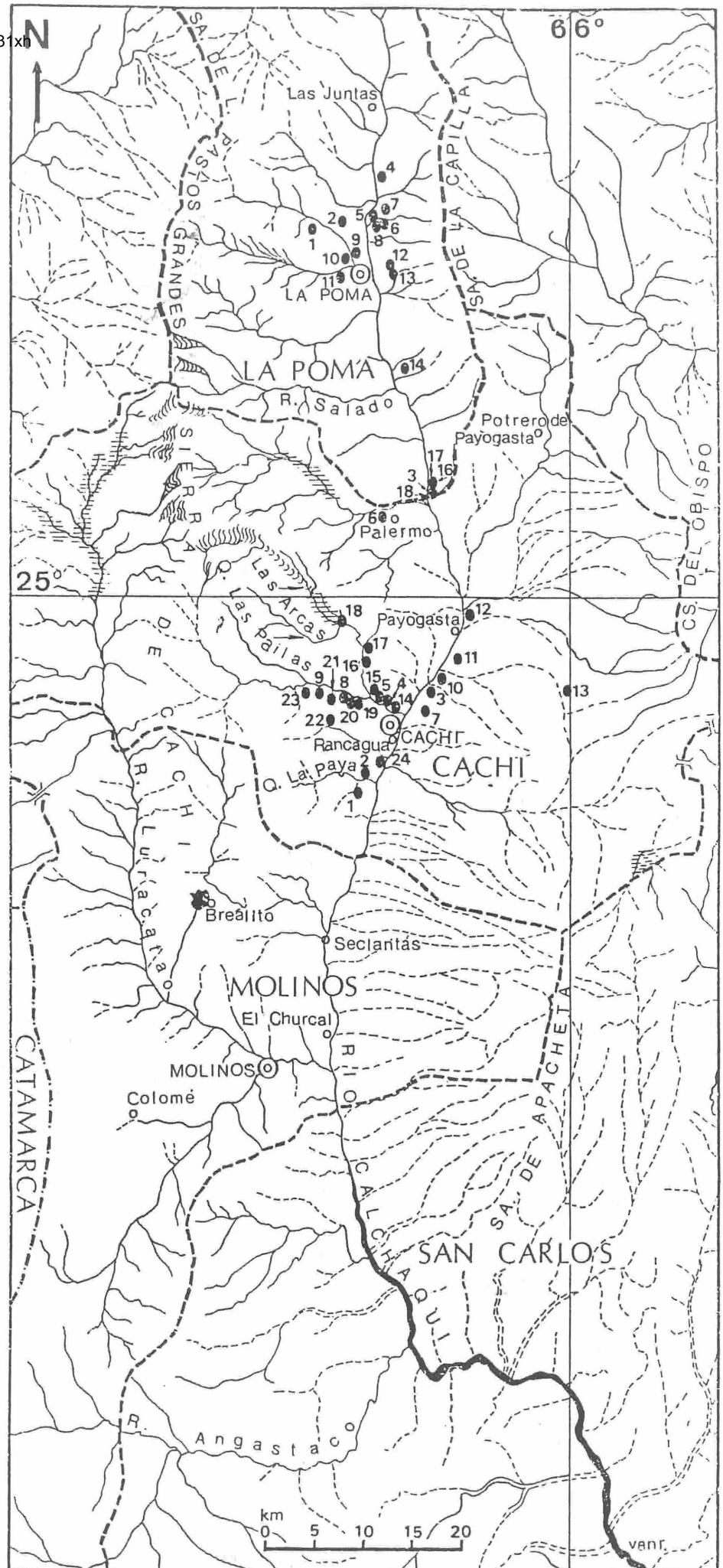
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Identifying Prehispanic Wood from Archaeological Contexts in Andean Argentina

Project's Goal:

My research encompasses the study of charred prehispanic woody material recovered from two Argentine archaeological sites. It also examines charred modern wood samples collected from the region surrounding the two archaeological sites. The archaeological sites are located in the northern end of the Calchaquí Valley in the province of Salta. One is an Inka constructed site (El Potrero de Payogasta: 42=) and the other was established by the Diaguita, the people indigenous to the area, but later influenced by the Inka intrusion (Valdéz: 12=). Due to the presence of the two disparate cultural and political groups in addition to dissimilar local environments, I expected to find differences in the way wood materials were used and deposited by the two ethnic groups.

My research began with charring modern wood in order to create a type-collection. This collection was used as a reference for the identification of the archaeological wood excavated from El Potrero de Payogasta and Valdéz. The objective of such comparisons was to ascertain whether (1) differences and/or similarities between the material recovered from the two sites could be ascertained and (2) variations in the plant remains excavated from the structures reflect the dissimilar architectural styles. This study can ultimately increase our knowledge about the past environment, the movement of materials (i.e. woody plant materials) into and out of the area, the availability of materials to different groups of people, how past cultures manipulated their environment and the plants found growing there, and cultural preferences and beliefs.

The importance of wood study

First, the objectives of wood identifications are to ascertain the possible (1) anthropogenic influence on the landscape, (2) changes of environmental surroundings, such as species of woody materials, through time, (3) differences and/or similarities between material recovered from several closely related sites, structures, and other site related space, and (4) wood species that were preferred or simply used because of its presence within a community.

One example of how the study of carbonized wood has played a major role in the way researchers interpret past environments and human manipulation comes from archaeological findings in the Somerset District, England (Newsom). Here, in what are called the Somerset Levels, many very well preserved wood trackways or raised walkways were discovered. These trackways, first constructed about 5000 years ago over a bog, were consistently rebuilt for nearly 3000 years. In conjunction with other disciplines, the archaeologists were able to piece together a use pattern that eventually drew a picture of the gradual deforestation of the area due to human activities. For example, the stronger heartwood of larger trees such as elm, lime, and ash was found to be almost exclusively used in the oldest trackways. The outer sapwood portion, the wood less resistant to decay, seems to have been discarded or set aside for purposes besides construction.

In comparison, the most recent of the many occupation levels exhibited a very different construction

technique, location of the trackways, and tree size and species utilized for building materials. Birch, a lower quality, wetland tree species that also produces usable secondhand or coppice growth, was the preferred building material. In effect, the shift from using strong high quality upland species to exploiting smaller wetland trees of poorer wood quality and a more conservative building style advocates that there were changes within the environment due to humans' direct intervention (Newsom).

Another example of how the study of charred wood has been successfully applied includes the systematic study of an Andean site located in the Jauja region of Perú (Johannessen & Hastorf 1990). In this case, wood samples were collected, dated, and examined from occupation levels encompassing a time period of 1000 years. The study shows that the Inka conquest of an area brought about shifts in the types of wood that was used. That is, those species found frequently in earlier samples were all but absent during later time periods, and vice versa. Also, high concentrations of wood in elite dwellings indicate that wood use is, in part, dependent on social order. This theory stems from the idea that with a deficiency of woody materials in the Andes, wood would become a valued item in Andean economies (Johannessen & Hastorf 1990). In addition, ethnographies and early Hispanic documents were consulted as to how wood is or was used in the area. These written documents all point to wood as being cultivated as a crop as well as possessing greater significance than purely domestic. In other words, the subject of wood is very complex and can be symbolic in its meaning (Hastorf and Johannessen 1991). The dynamic relation between social, cultural, historical, and environmental factors in the Andes all appear to influence the pattern of wood use. Thus, the placement or location, in addition to frequency, of a given species may have more importance than commonly thought.

These examples show how wood use can change through time, but there remains the question of how we know whether this shift does not solely demonstrate different conditions of preservation. Any work done in archaeology may be biased to some degree, whether it is the way the data were organized, the techniques of excavation, the researchers' own questions, the use of a material by a population, a naturally changing environment, or the preservation conditions. Nevertheless, patterns of variation become obvious through in-depth study, but it is up to the researcher to decide upon one or many hypotheses as to why such similarities or differences may exist in the archaeological record. Also, it is important that wood studies are not used independently. It is beneficial to use them in conjunction with other fields of study such as pollen analysis, ecology, and geography. As well, early writings, ethnologies, and present data on the environmental conditions can be invaluable resources when they are available.

Historical Overview: Cultural and Economical Importance of Woody Materials

Beginning around A.D. 1460 and ending after the arrival of the Spanish conquistadors circa A.D. 1530, the Inka empire (Tawantinsuyu) included most of the Andean region. The Inka empire encompassed the modern countries of Bolivia, Chile, Ecuador, Perú (the location of the Inka capital city of Cuzco), and northwestern Argentina. NW Argentina was incorporated into Tawantinsuyu around A.D. 1480 during the rule of Thupa Yupanki (A.D. 1470-1493) (Hyslop 1984).

From all reports, the Inka seem to have encountered little opposing force from the indigenous inhabitants.

Unlike the glorious stories of conquest that usually follow great Inka military feats, little mention or documentation of the takeover of southeastern Tawantinsuyu (Kollasuyu) has been discovered. Usually the Inka were very proud of their accomplishments and advertised their prowess by narrating stories that were often recorded later by the Spanish chroniclers. However, Kollasuyu has been mentioned only briefly in Spanish reports as well as in oral Inka lore.

With the takeover of NW Argentina, the Inka implemented their own system of rule and power. Inka control in NW Argentina extended across political, religious, and most often, social systems. Changes of economic importance comprised diverting and establishing trade routes; organizing and controlling agricultural production; and moving raw supplies, finished goods and people into and out of the region. As the Inka political structure was installed, roads were also constructed or rebuilt to ease travel between Inka way stations and administrative centers (*tambos*). The local heads of already established settlements were replaced by Inka administrators.

During the Inka rule, wood was an especially prized and regulated resource (Sherbondy 1986, Ansión 1986). Trees and shrubs were not only seen as valuable fuels due to their scarcity and excellent burning properties in the high mountains, but they had also acquired significant social and symbolic meaning in the daily lives of the Inka people (Hastorf & Johannessen 1991). Wood was perceived as a very acceptable and desired exchange medium, a religious symbol, and even as a link to the land and their ancestors. Since the indigenous people held wood materials in such high esteem, it could be that the Inka guaranteed their own importance by the deliberate cultivation of trees. This is reasonable, because the Inka political ideal included incorporating conquered people into the Inka system, and it would be likely that the Inka custom of regulation also was carried over as a tightly controlled production and distribution of wood and related products. Since the most valuable goods (e.g. wood) were reserved for those of higher standing in the Inka empire, it would be expected this discrepancy would appear as a greater amount of wood or the presence of specific types of tree species in the Inka archaeological record (Johannessen & Hastorf 1990). Accordingly, the strategies of Inka control and apportionment of wood resources could be addressed by identifying the carbonized wood excavated from Inka and contemporaneous indigenous sites.

The importance of trees before the Spanish conquest

Ansión (1986) and Sherbondy (1986) have both completed in-depth studies focusing on Andean and early Spanish views of the significance of wood. Trees and their wood held an important status within the many Andean cultures. Information about what wood meant to the Inka both in the concrete and spiritual sense is absent in the early Spanish writing probably due to the fact that the Spanish conquistadors and chroniclers were not interested in such practices. Instead they usually concentrated on other matters such as warfare and Inka "pagan" religious practices. Yet, many of the forests and wood supplies were depleted for the wood hungry Spaniards.

The Andean peoples used and treated the environment with respect and gratitude. According to Ansión, wood material often ordered relationships between families, was used in religious rituals, and above all, was

considered an important tribute item in the Inka empire. Sherbondy (1986) believes that this political concern can be recognized through the cultivation of trees, and the restrictions placed on who had access to the wood. She supports her theory by pointing to the clear distinctions made by the Inka between those who were carpenters, foresters, and wood gatherers among several job divisions. It is said that Tupac Inka Yupanki strictly regulated many activities such as hunting, fishing, mining, as well as wood collecting and cutting (Ansión 1986:41).

The Andean peoples had deep ties to the trees. First, trees represent many years of life. Trees are also said to be grandparents and even offerings are left for them (Ansión 1986:77). Leaving offerings for the trees is seen as reciprocal to letting the people use the fruit and wood of the tree. It is thus a sign of being willing to live in harmony with nature (Ansión 1986:78). Trees are the medium through which contact may be established with the underworld. Also they represent ancestors of a family line. A tree and its fruit were also considered by the Inka to be a communication link between humans and the gods. Thus, it is believed that the maintenance and care of the forests' trees stem not only out of concern for the preservation of the land's resources but also out of respect and utmost regard maintained for their ancestors and the ties linking the future to the other world (Ansión 1986:49). Also they represent ancestors of the ayllu which is a kin collective or a group of related individuals and couples who exchange labor and cooperate in the management of lands and herds (Mosey 1992).

In Andean society tree fruits symbolize the capacity to procreate; the seeds that are covered are associated in myths with unborn children in the mother's womb. Similarly, it is believed that the wrapping of Inka ancestor mummies symbolize the outside covering of a seed (Sherbondy 1986:12). The flowers from tree branches present during a marriage ceremony represents future children of the couple (Sherbondy 1986:18). Fruit of the molle tree was used to prepare chicha the ritual drink of the Inka.

Incorporation of the tree into the fundamental life cycle can also be inferred insofar that two Inka were openly associated with trees. Lloque Yupanqui, the third Inka of the Hurin of Cuzco, took his name from the *lloq'e* tree which is known for its very hard wood. The Inka used the *lloq'e* wood for weapons and authority emblems, such as a staff of office. The name Lloque is thought to have been used for evoking images of strength and authority as well as associations to family, ancestors and the people in general. The other Inca associated with trees is Wiracocha Inka who was from the third Hunan of Cuzco. Wiracocha is recognized as having initiated the large scale plan of planting of trees throughout the Andes. According to those species with which he is especially associated are the aliso, kiswar, chachacoma, and molle (Johannessen & Hastorf 1990, Sherbondy 1986:10).

Not only were people connected with the names of trees, but so too were many places given names of trees or their parts. A good example of this occurrence is found in Cuzco (Sherbondy 1986:10). Cobo even said Cuzco had a representative tree the "quinua", however, Cobo did not make a clear distinction between whether he was talking about the tree quinal or q'ewña (*Polylepis racemosa*) or the grain quinua (*Chenopodium* sp.).

Vertical control played an important role in the Inka's struggle to incorporate new lands into their empire.

Beside wood for fuel, fruits and nuts could be harvested from the wooded lands and shipped to needy areas of the Andes. Ansi3n (1986:34) cites an example in which Huayna Capac orders wood from the border land to be brought to Lake Titicaca, a distance of nearly 1500 km. With the difficulties involved in shipping large quantities of wood from one region of Tawantinsuyu to another, it would seem natural to somehow develop a forest management system or at least the deliberate tending of small stands of trees in order to produce enough wood for the population's consumption needs. The presence of willow (*Salix humboldtiana*) in Peru also seems to be supporting evidence that the Inka actively worried about the propagation of forests. This tree is thought to have originated from Chile and then brought northward (Sherbondy 1986).

Traditionally, gardens were maintained by family groups as they are often today. Trees were important additions to the gardens, for, the fruit, leaves, bark, and wood could be harvested when needed. During our field work in the Cachi area we visited one of these gardens and actually were allowed to collect some wood and plant materials for the botanical collection. The idea of gardens date back even to the time of the Wari (AD 600-1000). Many trees (*pati: Carica augusti*) associated with what are thought to be garden enclosures are found throughout their area of control (Sherbondy 1986).

The importance of wood is also manifested in the strict protection of the natural resources in the Andes by the policies of the Inka. Trees are the subjects in many myths as *huacas* as well as symbolizing the *ayllu* lines of descent (Ansi3n 1986). Another association that has been further researched is the tree in relation to the jungle, danger, and the lack of culture. Many of the forested jungles were approached as a place without civilization and often avoided (Ansi3n 1986, Sherbondy 1986). Such evasive actions could possibly have stemmed from the difficulties that the highland people had living in the great forests or the great effort needed to subjugate peoples of the eastern Tawantinsuyu border. In other words, trees were also associated with the unknown and danger as well as prosperity and high status. Thus, it is reasonable to think that the Andean made a distinction between the higher elevated Andean forests and the jungles. The jungles were also viewed as important due to the advantage of controlling several different types of environments.

Ansi3n (1986:46) mentions that *sacha* signifies a mature tree, *sacha runa* is associated with the jungle and *mallki* which is used in general to mean tree and more specifically a young tree, and even ancestor. The tree also is pictured as representing the entire Inka genealogical line. It is thought that either the molle or the kiswar were the tree chosen to represent this ideology (Ansi3n:47), however, today many tree species have been identified as symbolizing ancestral lineages (Sherbondy 1986).

Andean tradition includes wood as an important item given and received through reciprocity (Guaman Poma 1978). Wood is considered a valuable commodity in areas with few resources, the possession of such important objects, and thus, the ability to give "expensive" gifts means the attainment of higher status for the individual who has access of wood (Johannessen & Hastorf 1990:77). This idea of reciprocity was played upon and expanded by the Inka in that wood became a typical item of tribute (Ansi3n 1986:36). This fact has even been commented upon by Spanish chroniclers. Wood tribute was in turn transported far distances, often ending up in the Inka storage houses or used for rituals in the religious centers. According to Guaman Poma (1978), grass and wood were often used and collected together. The collection of this resource is also said to

have been the work of the young and old. One of the uses for the quipu were to keep records of the tribute brought in by the Inka's subjects. This accounting system kept such information as to quantity and type of tribute being given by each community in the empire. In the case of fuel, similar categories were kept together on a string (Johannessen & Hastorf 1990:72).

Another important use of wood within the Inka empire included bridge construction. Species that were recorded as being used for this purpose include chachacoma (*Escallonia resinosa*), chilka (*Baccharis lanceolata*), and mutuy or tankis (*Cassia* sp.). Willow (*Salix humboldtiana*) was also probably used. Neighboring villages took care of the bridge maintenance and cared for the trees and their planting as well (Rowe 1946, Ansi3n 1986:42). Ansi3n (1986:43) also believes that larger support poles were made of aliso. Aliso was used because it was tall and had straight trunks. In addition, Cobo (1979) says that this tree could be located through every province of "Peru". Other trees besides aliso that are thought to have been generally favored by the Inka were kiswar (*Buddleia incana*) and kolle (*Buddleia coriacea*) (Ansi3n 1986:43).

Molle (*Schinus molle*) is a tree which has been put to many uses during the Inka rule. This tree (*Schinus molle*) typically grows in altitudes up to 3400 m. The molle fruit was consumed in the form of chicha, honey, and vinegar; the resin was applied on burns, embalmed the bodies of the dead, and used as a purgative; the leaves were also used on burns and skin infections as well as functioning as a good bug repellent and bandages (Ansi3n 1986). Lastly, molle was reserved for fuel and ritual purposes. For example Cieza de Le3n is cited as saying that sacrifices were performed near the molle tree because the trees were considered sacred. Also, these trees were often consulted as oracles.

Trees and their cultivation were integral elements in both the ecology and culture of the Andes in prehispanic times. This has been considered so due to all of the evidence pointing to such a practice. First, there is written documentation reporting the care given to the trees and plants in general. Also, there is both modern and archaeological evidence of the careful management and placement of trees. Third, there is a large number of terms used in the Inka language of quechua which refer to trees in general as well as to the act and results of taking care of them (Sherbondy 1986:7). For example, *mallki* is the quechua term for "cultivated tree". It is also associated with a tree planted by humans, a transplanted tree, and often a very young tree (Sherbondy 1986:7). In addition, there are many other words with *mallki* as a base yet which still reflect the main idea of tree or the planting of a tree. Wood's importance can be elicited from the multiple meanings of the terms for wood.

Environment and Plants of the Northern Calchaqu3 Valley:

Aparicio and Difrieri (1963) divide Argentina into large ecological regions which constitute closely related as well as dependent vegetation species. Accordingly, the northern sector of the Calchaqu3 Valley has been generally categorized as a region of prepuna. The most distinguishing species in this region include both large and small cactus, zigofilaceas, and leguminous and composite bushes. Generally speaking, the prepuna region stretches from the province of Jujuy in the upper NW corner of Argentina to La Rioja over 600 km to the south (Cabrera 1976). Typical to this area are mountain slopes, volcanic cones, and rocky quebradas.

Soils originate from eroding mountain slopes, and thus consist of loose sand and stone which greatly facilitates the movement of surface moisture to deeper depths. The climate is dry with notable seasonal temperature variations. Winter temperatures can dip below freezing and during the summer months temperatures often remain around 40°C. There is little precipitation throughout the year except for the torrential spring rains which leave many modern roads impassable for several days. Rainfall in the prepuna fluctuates between 30 and 35 cm per year (Aparicio & Difrieri 1963). The most typical types of vegetation found in the prepuna environment are short plants and larger *Trichocereus* cactus (*T. pasacana* more in northern Salta and *T. terscheckii* in the south), also known as the "cardón" cactus. Cactus thrives in the gravelly soils and rocky debris of the region. This cactus is typically found in conjunction with "jarilla" (*Larrea divaricata*) (Achreche et al. 1989). It is possible that the jarilla encourages the growth of the cardones by acting as a "nurse plant". Such a relationship between species is also found in the Sonoran desert in Mexico and the Southwest United States between the *L. divaricata* ssp. and the saguaro (*Carnegiea gigantea*). Thus, the distribution of jarilla may considerably affect the presence of the cardón as much as other environmental factors such as altitude, water supply, or temperatures.

A study regarding the growth and distribution of the cactus *Trichocereus pasacana* (cardón) was completed in the Tin Tin Valley a branch of the Calchaquí Valley. The Tin Tin region lies 3000 m above sea level and receives on average 10 cm rain/year. It was found that those cardón cactus between the heights of 1.5 m and 2.5 m were typically absent from the population because they were exploited for their wood. The most common uses of the cactus wood were for construction purposes and crafts.

Although few in number there are several tree species which grow in the prepuna region. Today, it is common to find eucalyptus trees (*Eucalyptus globulus*) in the towns in the Calchaquí Valley as well as throughout the Andes. Yet, this tree is not indigenous to the area and was introduced from Australia to Cuzco as recently as the 1880s. However, the eucalyptus often does more harm than good (Sherbondy 1986:8). First, this tree depletes the soil of essential nutrients. Second, it does not return nutrients to the soil in the production of good humus, and third, it needs a lot of water which can be damaging to the scarce water supply. Other frequently found species in the quebradas of the Calchaquí Valley are *Prosopis ferox* or churqui. Churqui is a small thorny tree which can reach the height of four meters in optimal condition. It is usually found growing in small groups of the same kind. Arca (*Acacia visco*) a leguminous tree, also is typically seen in the valley and tends to congregate with others of its type. This tree grows 4 to 6 meters tall and is usually found at the bottom of the quebradas between the altitudes of 1800 and 2800 m. Also associated with these copses are *Schinus areira* ("molle"), *Lithraea ternifolia*, and various species of *Prosopis*. Thickets of molle (*Schinus areira*) and chilca (*Baccharis salicifolia*) are also common along the quebrada bottoms and at river edges. These shrubs range from 1 to 2 meters in height. Cortadera (*Cortaderia rudiusscula*), a 2 m to 3 m tall graminea, is also just one other species typically found along river banks.

In the prepuna areas agriculture is relatively constricted because of the rugged terrain and the limited water supply. However, Cabrera (1976) notes that with irrigation it is possible to grow alfalfa, various types of maize, quinoa (*Chenopodium quinoa*), ataco (*Amaranthus mantegazzianus*), oca (*Oxalis tuberosa*) as well

potatoes (*Solanum* sp.). In many quebradas apple, peach, walnut, and membrillo (quince) trees are grown.

Some of the flatter valley bottoms of the Calchaquí resemble the monte region which stretches to the west and south. Namely, this landscape consists of plains, mountain slopes, and small mesas (Cabrera 1976:36). The deep, sandy soils are very permeable as well as rocky and salty. There is larger and less sparse woody vegetation in this area compared to the upper or mountain slopes of other pre-puna lands. The growth of "jarilla communities" is typical in the sandy and rocky soils of the valley bottom (Cabrera 1976). Various species of jarilla (*Larrea divaricata*, *L. cuneifolia*, *L. nitida*) are found together with several other bushes which do not grow taller than 2 meters. *Prosopis* sp., *Cassia* sp. and *Cercidium* --more specifically, brea (*Cercidium praecox*)--are just a few species found in conjunction with the jarilla. On the outer edges of these communities isolated cardón cactus (*T. terscheckii*) are a common sight.

Besides the jarilla communities there are also other woody plant communities, for example, algarrobo forests (*Prosopis* sp.), thickets of jume (*Allenrolfea vaginata*, *Suaeda divaricata*, *Heterostachys rilteriana*) and pichana (*Cassia aphylla*). Algarrobos are typical of thin soils and are located along or above permanent water sources. Some other species also associated with the algarrobo include brea (*Cercidium praecox*) and chañar (*Geoffroea decorticans*). The wood of these trees have been very important fuel and wood sources, and thus have largely been destroyed over time (Cabrera 1976:40). Cabrera (1976) also notes that these trees are slowly dying due the depletion of aquifers and the spread of sandy dunes into regions traditionally favored by the *Prosopis* sp.. Also, particular to this region are the aliso or pájaro bobo (*Tessaria integrifolia*) and sauce or willow forests (*Salix humboldtiana*). These trees grow well along watered river banks and streams. Other woody plants characteristic of this area are various types of shrubs with the common names of churqui (*Acacia* sp.) and tusca (*Acacia aroma*). Here human activity consists of herding and along water sources irrigated agriculture is practiced.

Architecture

Kendall (1985) describes *tambos* as a type of royal lodging or house that was fairly regularly spaced along the royal Inka road. Pachacuti Inca is said to have initiated *tambos* throughout the Inka empire although many are thought to have been already in use by the time Pachacuti came into power (Kendall 1985). No matter who implemented the practice of constructing *tambos*, military centers were usually built by the conquering Inka since the area into which they moved rarely had usable installations (Hyslop 1990:5).

Rectangular structural forms were favored by Inka architects and are typically seen throughout the Inka empire (Kendall 1985:17). However, Inka would alter the shapes of their buildings to suit better irregular terrain when true rectangular forms were not feasible. Yet, rectangular buildings predominated in all manners of Inka life--domestic, political, and religious. Other forms that are also encountered include circular and semi-circular (U-shaped). A building's function usually played a role in the decision as to what shape it would take (Kendall 1985). For example, semi-circular or U-shaped buildings are often reserved for important military or important buildings. The Qori Kancha in Cuzco is one example of a U-shaped structure. This building was placed at the center of the Sun worship and is considered today to be the house of the sun

god, Inti. Large circular structures are thought to have been dwelling sites (Hyslop 1990:8). One major use of the circular structures is found in the construction of Inka storage houses, though, rectangular buildings were employed as storage places as well (Lennstrom 1992). But in general, circular buildings are rare and are attributed to local influence outside of the Cuzco area.

The rectangular structures were usually single storied with a gabled (two slopes) or hip (four slopes) roof; the hip roof is thought to predominate (Kendall 1985). Both types of roofs had timber frames that were interwoven with smaller saplings and thatched with ichu grass. Slightly larger central supports rested on a frame or were placed on top of the walls (Bouchard 1983, Kendall 1985). Occasionally second stories or attics were also built, but these levels had separate entrances and usually could be accessed by high terrain, a rope, or a ladder. Simple sloped or single sloping roofs were also found. The walls for all of these could be either slopped or stepped. Circular or almost circular structures are believed to have been roofed with conical shaped roofs. These too were topped with thatch and wood frames.

Construction was usually carried out on an already level or leveled ground surface. This leveled earth was subsequently used as the structure's floor surface after it was beaten (Kendall 1985:22). Sometimes platforms were built inside, thought to be used for sleeping platforms, consisting of either wood, earth or stone and often built into the structure. Doors, symmetrically arranged along the front of buildings, rarely vary in size when similar function is concerned (Kendall 1985:26).

Building materials usually consisted of a combination of components. In most Andean regions the restricted access to large trees had limited the widespread use of wood for structures. However, wood wrapped in rope was sometimes adopted for lintels, second story flooring, and roof frames. If larger scale building with wood was to be made it often had to be imported (Kendall 1985:51).

Besides domestic structures, there were many special governmental and religious functioning buildings. For example, a typical site consists of (1) a central plaza with an *ushnu* and (2) a *kallanka*. The *ushnu* are found located in the main square of an Inka tambo, town, or outpost. *Ushnu* are considered to define the centers of Inka planned and built settlements in the regions outside of the capital city area (Hyslop 1990:69). These constructions were central to the site and are believed to have been the seat or dais of the Inka or a stone altar. *Ushnu* vary greatly in size and elaboration but they generally are rectangular shaped platforms. However, they can be as rustic as a pile of stone. Some uses associated with them include governmental, military, and ceremonial. In some cases, they seem to have been used as places of sacrifice and fortified retreats. According to Kendall (1985:67), Manco Capac ordered *ushnu* built in every quebrada. Kendall (1985) also says that Huayna Capac ordered the *ushnu* to be built at the head of the quebradas with the function of lookouts. The *ushnu* are also considered to be symbols of the uniting of the common people with the Inka or nobility (Hyslop 1990:71). That is, the plazas were reserved for the common people and the *ushnu* for the Inka or the elite class. Zuidema (Hyslop 1990:69) has stressed the importance of the *ushnu* for astronomical observations especially in regards to the *ushnu* in Cuzco. Yet they are primarily considered to be an outdoor center of ritual activity where such activities as ceremonies and *chicha* sacrifices were held.

Another building typical to an Inka settlement was the *kallanka*. These structures, considered halls by

Hyslop (1984), are long, open, and rectangular with gabled roofs. They are situated along the Inka's central plaza and usually had a single door opening up into this central area. *Kallanka* are believed to have housed travelers, workers, soldiers or government workers on state business (Hyslop 1990:18). These large buildings were also likely used for ceremonies in conjunction with the central plaza and the *ushnu*.

The Archaeological Sites:

El Potrero de Payogasta is an archaeological site located at the northern end of the Calchaquí Valley next to the Potrero River. The area of NW Argentina in which we worked is considered to be generally a prepuna environment (Aparicio and Difrieri 1963). Yet, it is also closely situated to the ecological borders of the higher puna, lower areas of the southern monte, and more forested western lands of the Chaco district (Cabrera 1976). However, due to the variation between mountain and valley altitudes there are smaller ecological differentiations within the larger prepuna designation, which makes it very difficult to classify the region with such a general term. Several types of vegetation may be present in a relatively small area--shorter shrub and grass land on the mountain valley sides and shrubby forest in the river valley bottoms. This distinction in vegetation of higher and lower altitudes can be very obvious. Through observations made during field research, vegetation at Potrero includes a more prepuna type of plant life.

Situated on a hillside 2800 m above sea level yet between the craggy cordilleras that delineate the valley edges, El Potrero lies just above the river that is the major water supplier. El Potrero is considered to be an Inka tambo constructed after the arrival of the Inka into the valley area between 1470 and 1493. Despite this resource, however, the region is semi-arid to arid. The major vegetation is cactus (*Trichocereus* sp. and *Cereus* sp.), small shrubs and bushes such as jarilla (*Larrea divaricata*, *L. cuneifolia*, *L. nitida*) and jume (*Suaeda divaricata*, *Allenrolfea* sp., *Holmbergia* sp., *Heterostachys* sp.). The only trees growing in this area line the river banks and irrigation ditches; for example, willow (*Salix* sp.) and molle (*Schinus molle*, *Lithrada mollerides*, *Schinus areira*, or *Schinus polygamus*). Other woody water-loving plants such as cortadera (*Cortadera dioca*, *Scirpus giganteus*) are also found along the river's course.

The presence of the *ushnu* and *kallanka*, structures found at major Inka *tambos* throughout Tawantinsuyu, seem to suggest that El Potrero de Payogasta was an important Inka political and administrative center (Hyslop 1984). In fact, these buildings are believed to have been the foci of Inka political centers. Thus, it is reasonable to suppose that El Potrero de Payogasta was the site where prestigious individuals within the Inka empire lived, worked, and governed.

Valdéz, a site consisting of low circular and oblong mounds (*montículos*), encompasses about 60 ha and lies approximately 20 km south of El Potrero de Payogasta. This site is situated 2300 m above sea level and stretches across the flat mesa directly above the Calchaquí River into which the Potrero River flows further north. Valdéz is thought to have been one of the larger indigenous population centers, an interpretation supported by early but brief written accounts as well as archaeological remains excavated from the site.

Valdéz, which sustains a monte type vegetation, is crossed today by seasonal arroyos or washes that are lined with larger trees such as molle as well as eucalyptus (*Eucalyptus globulus* Labil.), willow (*Salix* sp.),

and poplar (*Populus* sp.) which were introduced to the region in the colonial period--the last two perhaps even earlier. In this area cactus is practically absent, but an overgrowth of shrubby brush is scattered across the land (e.g. jarilla and jume: *Allenrolfea vaginata*, *Suaeda divaricata*, *Heterostachys rilteriana*). Smaller trees such as algarrobo (*Ceratonia siliqua*, *Prosopis* sp.)--once a very important food source for the indigenous people, churqui (*Prosopis ferox*, *Acacia caven*), tusca (*Acacia aroma*), and brea (*Caesalpinia praecox*, *Cercidium australe*) are also distributed throughout the site.

From my observations, many of the constructions at El Potrero seem to be constructed in the traditional rectangular Inka style. However, a number of larger circular structures have been incorporated into the central area of this Inka site to the south and southeast of the *ushnu*. Besides the Inka style buildings, there seems to be a complex that demonstrates the local indigenous tradition (Tarragó 1977, 1978). In this sector of the site the rooms or compartments are located directly off the main wall and in the form of a comma. This complex lies just to the southeast of the main *ushnu* plaza. During field work in the area three types of roofs were noted for rectangular structures: hip, gabled, and simple. No circular structures were seen. I believe that the roof construction today is very similar to what was built during the occupation of the Inka--cactus and cane-stemmed plants were used as the primary building materials. Adobe bricks on a base of mortared field stones is frequently found and seems to have been a common feature at El Potrero.

Making a reference collection: Modern Wood

The first phase of my research involved creating a modern carbonized template against which I would be able to compare the archaeological wood pieces that we collected at and near the sites of El Potrero de Payogasta and Valdéz. In addition to discussing my project with my advisor Dr. Christine Hastorf, I consulted Sissel Johannessen about how to proceed with wood identification. Ms. Johannessen has completed similar projects with Peruvian and North American wood remains, and provided valuable advice regarding the material I needed in order to create a modern wood type-collection (see Johannessen & Hastorf 1990, Hastorf & Johannessen 1991). She also gave me many suggestions as to how both the modern and archaeological samples should be examined.

Before I began to make the modern type-collection, it was necessary to review all of the plant material collected during the 1990 summer field season. At this time I also chose the woody material that would be charred. After selecting those plants appropriate for my study, I reread the field collection notes to double-check the numbers recorded on the tag of each specimen, and on these forms I recorded those specimens that were selected to be charred. As I was processing the wood, I completed the whole carbonization procedure for three to four samples per taxon. Limiting the number of pieces of wood being processed to four at a time made it easier to record the results of each individual piece, for descriptions of each step of every procedure were kept throughout the completion of the project.

I burned five pieces of wood from each numbered specimen suitable for the study when it was possible: three with a larger diameter and two of a smaller diameter. I sawed off segments approximately 3 inches long from branches, twigs, and when available (for only two samples), roots. I proceeded to write the collection

number on both of the ends of the sample which were rather smooth, or on the side of the specimen if the ends were too small. I used a soft graphite pencil because the graphite mark, if heavy enough, remained on the piece throughout the charring process. Therefore, with these fairly permanent numbers already on a piece, it was easy to identify a sample after it was burned. Next, I wrapped each piece tightly in aluminum foil to retard oxidation.

The wood was charred over a Bunsen burner after it had been placed in an empty metal can and then covered with aluminum foil. I laid three to five pieces of wood flat across the bottom of the can where the heat was the hottest. When no smoke was escaping from the can, I checked the wood for charring by breaking the smallest piece in half. If the wood was done, I snapped the other pieces in two, beginning with the smallest pieces and successively checking the larger ones. Those incompletely burned were left in the can and checked at half hour intervals. A total of 30 modern wood specimens were charred and then placed in boxes labeled with the sample's field collection number for easy referencing later.

Originally I cut pieces that had varying but larger diameters, for I felt that if I took into account that there would be slight variations, I would be able to distinguish the wood's characteristics more easily from a larger piece of wood. However, extensive variation between a single species of tree, even with the very same individual plant was seen in the modern collection. Thus, it was not until after I examined all of the modern samples under the microscope and began looking at the archaeological wood fragments did I go back and char twigs as small as 1 mm in diameter.

A sample took anywhere between a half an hour and seven hours to finish. Burning time depended predominantly on such factors as the size, thickness, and the type of wood. The position of the wood in the can over the flame also affected the length of time each sample required to completely char. For example, if the wood pieces were not laid flat in the can, only the end touching the bottom would burn. Thus, I had to burn the whole piece longer. Not only was the time extended, but I also risked over-charring the already charred end. A burning flame can also greatly distort and destroy the wood features if allowed to burn freely. Thus, it was important to keep lower burning temperatures, otherwise unidentifiable specimens resulted.

Examination, Drawing, and Description: Modern and Archaeological Wood

The next step of my research included examining, describing, and then drawing three sections of each piece of wood. These sections include the transverse or cross-section, the radial section, and the tangential section. Specifically, I looked at how various features were arranged compared to other characteristics of the wood, the sizes and shapes of these features, and their frequency.

Initially I viewed the charred pieces from three different directions using a stereoscopic microscope. That is, I looked at the visible portion when broken in a transversal, tangential, and radial direction to the given wood piece. However, after the complete examination of the modern wood samples, I realized that the radial and tangential surfaces showed features that were too small to be seen clearly and described correctly with the level of magnification available; and hence, I was rarely able to use the analysis of these two angles. Therefore, I finished the study by drawing and describing only the transversal sections of every piece. Yet,

by not using these views, the accuracy of identification is reduced for these sides are indeed very crucial. Some wood types can be differentiated or identified only by comparing all three angles (Core et. al. 1979, Hoadley 1990).

As I examined the individual pieces of wood, I found that it was most expedient to record the characteristics of the wood's annual rings, pores, rays, and parenchyma. These traits are seen most distinctly on the transversal section. Annual rings were described as to how they were delineated, that is, whether they were ring, semi-ring, diffuse porous, or any combination of these forms. Pores were generally described as having a specific frequency, shape, size, and arrangement. The presence, length, width, color, and distance apart were most frequently noted attributes regarding the rays. Parenchyma was described as to its presence or absence and its location in relation to the position of the pores. These three characteristics were not the only ones I relied upon, however. The direction in which a type of wood tended to fracture, the preservation state, and any other trait that seemed helpful in clarifying the structures and make-up of a specific sample of wood were also duly noted.

In addition to the physical characteristics of a piece of wood, the impressionistic descriptions were also important (Johannessen pers. comm.). Such properties as 'soft', 'hard', 'crumbly', and 'easily broken along the ring' helped when making comparisons as well as minimizing the need to *remember* what every single piece looked like. However, not all plant species have every feature mentioned above. For example, monocots do not have pores or rays but structures called vascular bundles. These bundles have their own characteristics: they resemble small faces when seen from the transversal section. In other words, it was essential to note every characteristic that might provide any assistance in identification as each sample piece was identified.

5x8 cards were kept with a drawing and careful description of each specimen, both modern and archaeological, examined in the study. Originally the pictures were drawn at different magnifications--anywhere between 16x and 75x magnification. However, viewing the carbonized fragments with varying levels of magnification often caused discrepancies in the outward appearance of the wood. Therefore, I developed a consistent routine of examining each wood piece: a fragment was reviewed at 6.4x, 16x, 40x, and 60x magnification--the last two were magnifications from which my drawings were made.

After all of the sketches were completed, I recorded the probable species of each wood piece on the card. These identifications were made based on the names recorded in the field collection notes, published journals and books, and help from Sissel Johannessen. Hopefully more exact species designations will be received from the Missouri Botanical Garden where whole plant specimens were sent for more complete identifications.

Methods and Selection:

I have analyzed 33 different proveniences. Archaeological proveniences in this study are specific locations within a site and are designated by seven numbers. Each number more discretely identifies the cultural context of the excavated material. The first number denotes the site's registered number. Often large sites are divided into smaller but general sectors in order to simplify locating an object; thus, the second number. The third

number refers to the type of architectural feature within a division (i.e. patio, round structure, square structure). The fourth number denotes a further and more regular (but still arbitrary) subdivision of the architectural feature into units which are usually 1.5 m x 1.5 m squares. The fifth and sixth provenience number respectively, are references to the level of cultural stratigraphy and the locus which represents a different cultural context within a single level. Finally, the seventh number denotes the exact measured position (point provenience) from which a flotation sample or any other cultural remain was taken. This point provenience is indicated by a slash and then a number.

Sampling from different archaeological contexts throughout the two sites was also an important part of my research. When possible, I sampled several proveniences of various architectural divisions as well as structure types. I chose to concentrate my study on the Inka settlement of Potrero de Payogasta as it was more extensively excavated, sampled, and better defined contexts than proveniences explored at Valdéz. At the start of this project we predicted that the types of wood found would vary to the greatest degree when the two sites were compared with each other. We also anticipated that the types of wood would differ when comparing different types of structures within the same site, only that these differences would be less noticeable. Thus, as I was selecting archaeological samples for study, I chose specific proveniences within structures that I thought would best address questions regarding the type(s) of wood the Inka and the indigenous population were exploiting. My method of selection includes sampling proveniences from structures which represented various class ranks and forms of construction. As well, we decided that I should work with the proveniences that were regarded as consisting of the 'occupation zone' of a structure. We felt that this level would produce wood remains related to daily activity, and besides, use activities are most likely to be found here than either deeper within the floor layer itself or the rubble excavated from above. Thus, this wood may give us a good perspective on which types of wood were being used.

A further determiner of which proveniences were to be sampled was whether the level of occupation had a sufficient amount of wood from which I could randomly select at least 20 pieces from both screen and flotation samples (i.e. samples which contained more than 30 pieces). Screen samples consist of carbonized wood pieces that were recovered from a 1/4 inch mesh screen. This screen was used to sift the soil after it had been excavated in order to recover those artifacts overlooked *in situ*. Flotation samples were approximately 6 liter soil samples from which carbonized material was separated from the matrix with water by using a mechanized water flotation system based on the SMAP type flotation system (see Arnott and Heyne n.d., Watson 1976).

In total I examined thirty proveniences from El Potrero de Payogasta and three samples from Valdéz. The types of proveniences from El Potrero de Payogasta are from the following constructions: 8 rectangular structures (including one sample from the kallanka), 6 circular structures, 11 patio or enclosed open areas, 3 samples near the base of the ushnu, and 2 samples from the interior of vessels. Three occupational zones, one believed to have been from outside of an adobe type of structure, were sampled from Valdéz. In total, I have examined 591 fragments of wood from these proveniences--531 from El Potrero de Payogasta and 60 from Valdéz.

Twenty archaeological wood pieces were chosen randomly by removing the wood pieces with a tweezers from the vial in which they were stored. The first pieces that were placed onto the table were kept for study. I proceeded to describe and draw these pieces following the same outline as with the modern wood. Including both El Potrero and Valdéz sites, a total of 140 fragments out of the 591 were unidentifiable. This was due to either the state of preservation and/or the size of the wood fragment.

After I had recorded down the necessary information for each sampled archaeological wood piece, I once again reviewed each fragment by holding it directly next to others that I thought might be the same. With this method I was able to form more definite relationships between the various pieces of wood, and at the same time, I was able to group similar archaeological fragments together as a "type". Later I gave distinct letters to the individual prehispanic wood types (A, B,...AA, AB, etc.).

Results:

At this time I have identified prehispanic wood types, some more tentatively than others (Table 1).

Table 1: Identifications of Wood Types from El Potrero de Payogasta and Valdéz

| TYPE | IDENTIFICATION |
|-------|----------------------------|
| A | Cactaceae sp. (cactus) |
| AM | 1990-47, 1990-72 "molle" |
| AN | 1990-71 "jume" |
| AS | 1990-6, 1990-32 "jarilla" |
| BD | 1990-15 |
| BF | 1990-8 |
| R-2 | 1990-60 |
| unid. | unidentifiable wood pieces |

To date, I have recognized 54 different types of wood at both of the archaeological sites--El Potrero de Payogasta and Valdéz (Figure 1). Seven types (A, AM, AN, AS, BD, BF, and R-2) can be identified in the modern wood collection. At least 47 different wood types were found at El Potrero de Payogasta and 24 at Valdéz (Figure 1). While both sites demonstrated a great diversity in specimens each contained many types unique to the respective site, only 17 types were found at both sites.

I began my study by comparing wood densities from different soil sample types and provenience unit-level-loci within both sites. I examined charred wood pieces from two different types of soil samples: screen and float (scatter and bulk). Density is considered for my purposes as the count of individual fragments per unit volume of soil sample collected. According to screen samples, those proveniences which are usually expected to contain wood, i.e. middens, pit fills, and hearth, had the highest densities (Appendix B). Yet by comparing float samples in order of decreasing density, contexts that were expected to yield large quantities of charred wood were not always the richest in such material. Instead, a much more varied relationship between context and density is recognized. There does not seem to be an obvious relationship between the cultural

context and number of pieces recovered.

For my study it was also essential to compare the relative percentage in which the different types occur at both El Potrero de Payogasta and Valdéz samples as well as within the individual proveniences in order to better appreciate the overall picture presented by the existence of certain types of wood in the archaeological record. Relative percentage can be defined as the total number of pieces of a specific category (e.g. type) divided by the total number of all types. This result was usually written as a percentage. In order to calculate the percentage of each identifiable wood type in a sample for every site or provenience I divided the total number of pieces of each identifiable type by the total number of identifiable pieces in the respective sample and multiplied the results by 100. For example, type AA from El Potrero represents 11.6% of the 412 identifiable pieces (Figure 1). The calculations are as follows:

531 charred wood fragments were examined at El Potrero; only 412 were identifiable.

48 fragments of type AA pieces were seen at El Potrero out of the 412 identifiable fragments.

Thus, the percentage of the identifiable fragment type AA at El Potrero equals:

$$\frac{48}{412} \times 100 = 11.65 \text{ or } 11.7\%$$

My result was the percentage of fragments that I was able to identify within a single sample, or, the relative percentage. I used the same technique in regards to the calculations of the unidentifiable fragments. For example, I reviewed a total of 531 charred archaeological wood pieces from El Potrero of which 119 were unidentifiable. I then divided 119 by 531 and multiplied by 100. This resulted in the overall percentage of unidentifiable wood fragments at El Potrero: 22.4% (see Figure 2). These calculations were completed for each site and each provenience at both sites.

In sum, I compared the archaeological charred wood with regards to its density and relative percentage at the two sites. Especially, I closely examined the following contexts: 1) site to site, 2) between structures with similar contexts at Valdéz, 3) within single structures, 4) inside and outside single structures, and 5) between structures with similar contexts at El Potrero.

Besides the recognizable types of woods in Table 1, several points should be mentioned. First, similar but definitely disparate species have been placed within the several different type groups or sub-divisions, but here I will talk explicitly about "types". Those more notable and frequently recurring types that have been yet further sub-divided include AA, AI, BL, P, R, and V. The reasoning behind maintaining larger divisions is related to the limitations of low magnification. It is not always possible to discriminate between similar looking wood species or even group the same species within the same category due to growth irregularities without very high magnification and a view of three distinct cuts (Core et. al. 1979, Hoadley 1990). Therefore, my type-groupings are organized predominantly by the most prominent physical characteristics. For instance, I identified type A as a *Cactaceae* sp. or cactus plant (Table 1). Although it was possible to identify type A as being cactus, further separation of the various charred archaeological specimens into the exact genus was not possible. Yet in other cases wood types are so distinctive that it would be difficult not to recognize it as a unique category or type of wood.

In terms of frequency, types A, AA, P, and R were the most dominant wood types at El Potrero de Payogasta (Figure 1). AA, P, and R are all unidentified at this time. Although there is slight variation as to appearance within each type-group, each type seems to display characteristics unique to the individual category. As mentioned earlier, the breakdown within these types is incomplete as can be seen from Table 1. R-2 displays slightly different characteristics than R-1 and R-3. Yet, distinctions made here may have been growth or preservation related; thus, I refer to a general "R" type.

The most defining features of the cactus or type A are the width of rays (one cell), the large size of its pores (compared to other sample pieces), and the tendency of the parenchyma to surround the pores. Type AA, on the other hand, tends to have rays that are wider than two cells and very small pores. Type P has narrower rays (usually one cell wide), and round pores that often contain either resin, gum, or tyloses. Parenchyma is also a regular feature of type P. Type R has a ring-porous arrangement of pores with definite rays. The wood itself tends to char to a very deep black color as well as be relatively softer than other types.

Perhaps most interesting is the rarity of what is thought to be molle (*Schinus* sp.) or any other tree species believed to have been planted by the Inka throughout their empire (see Johannessen & Hastorf 1990, Ansi6n 1986, Sherbondy 1986). Although "molle" (Type AM) was found at both sites, its appearance was rare: 5 pieces total at El Potrero in 30 proveniences and only one piece was recovered at Vald6z between 3 proveniences. Yet, the sample sizes might have been too small to form an accurate understanding of use patterns.

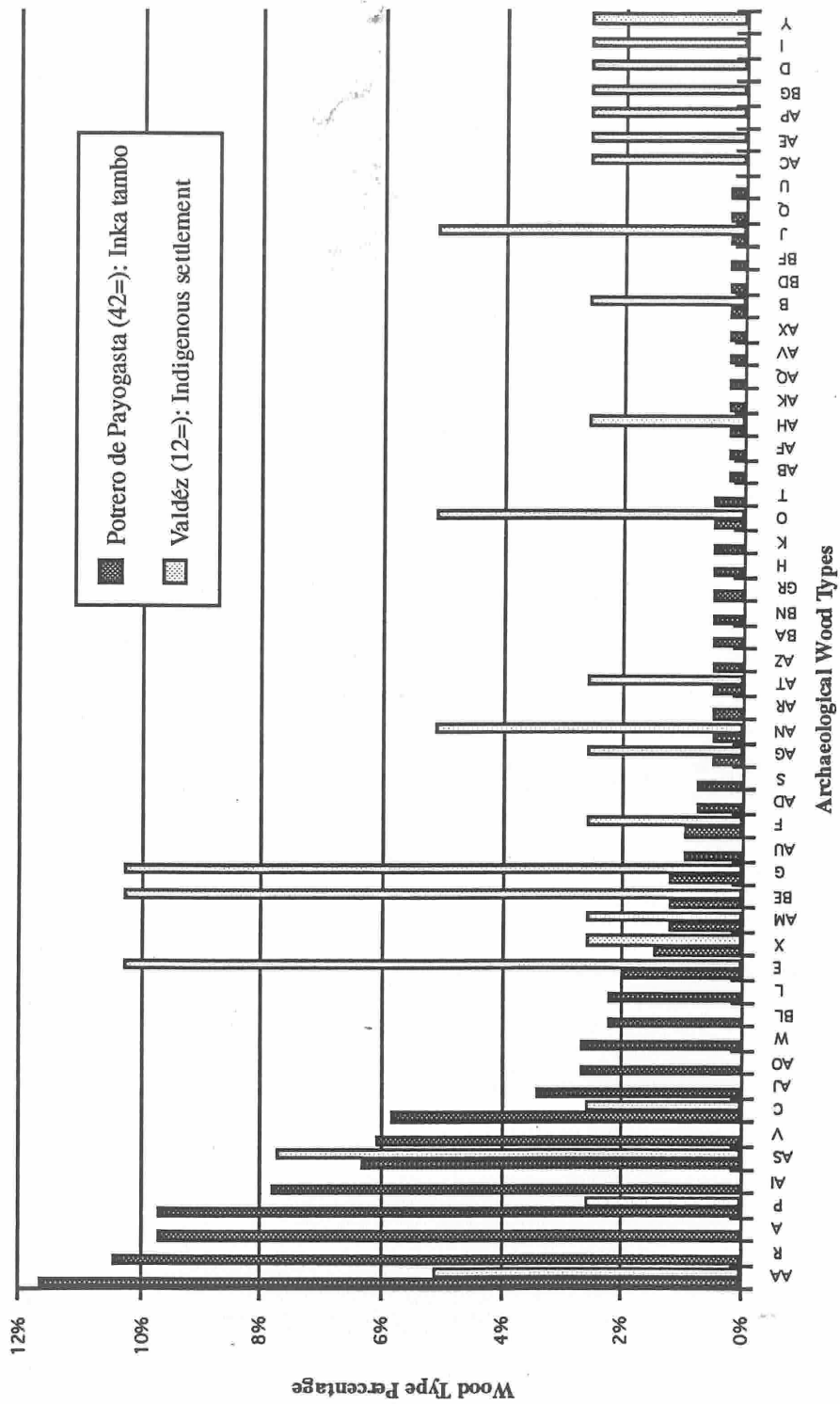


Figure 1: An Archaeological Wood Type Comparison-- El Potrero de Payogasta and Valdéz

Another significant observation was the absence of cactus (Type A) at Valdéz. Most likely this occurrence reflected the different ecological zone in which Valdéz is located. Today cacti prefer the rockier soils of El Potrero. Type AS ("jarilla") which was found in samples from both El Potrero and Valdéz is another type which should be looked at more closely. This identifiable type was prominent at both sites. It is a shrub found regularly throughout the northern end of the Calchaquí Valley. Further frequency comparisons are difficult to make due to the substantially fewer proveniences sampled from Valdéz, yet it was clear that the woody materials used at both sites are very diverse .

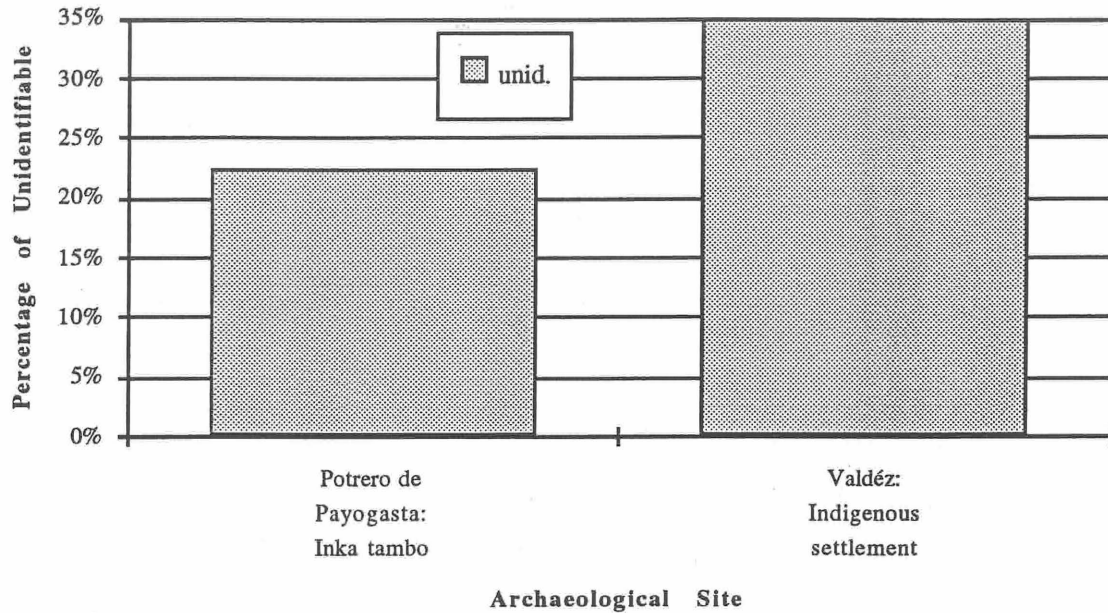


Figure 2: Frequency of Unidentifiable Archaeological Wood Types at El Potrero de Payogasta and Valdéz

Valdéz had more unidentifiable wood fragments than El Potrero (Figure 2). However, at Valdéz the pieces predominantly originated from only a single provenience of roof fall and floor surface material, namely, in the occupation zone of provenience 12=4-40 where 65% were unidentifiable (Figure 3). Otherwise the average number of unidentifiable wood pieces was similar to the average at El Potrero (approximately 25%). Preservation conditions, sampling methods, as well as the purpose for which the wood was used may have affected the percentage of unidentifiable charred material in the Valdéz provenience. All in all, there seemed to be a pronounced difference between the wood-types found at the two sites. This difference most likely indicated a disparity in the availability, and thus use, of woody materials.

Valdéz

At Valdéz I compared 3 use/occupation areas (12=1-50 vs. 12=3-41 vs. 12=4-40). On the whole, the cultural deposition at Valdéz was not well understood. This confusion was due in part to the lack of any standing architecture at the site and the irregular surface which consist of circular and oval shaped mounds

surrounding flatter "patio" areas. In spite of the fact that little was known about the general makeup of the site, insight as to individual provenience contexts has been gained through excavation. I concentrated on looking at the charred woody materials from the levels of occupation. The provenience 12=1-50 was excavated from what had been designated a "plaza" area or lower-lying flat area situated between a group of circular mounds. After excavation this provenience had been identified as both a habitation and a craft or metal production area. It appears to have been a provenience located outside of a structure, and more exactly, directly next to a wall of an adobe structure. This unit is also believed to be in one of the longest occupied areas at Valdéz.

The provenience 12=3-41 was part of a more isolated circular mound located in the southern half of the site. The exact context this provenience was difficult to ascertain, but a broad description was made in which the units were described as an area where generalized subsistence or domestic activities took place. This provenience was also noted as having several occupation levels. Provenience 12=4-40 was also located on a circular mound, but was in the farther eastern edge of what is presently known of the Valdéz site. The circular mound seems to have been associated with a group of circular and longer lineal shaped mounds. The reason that I chose this provenience was because more complete field notes were available and it is considered a possible occupation zone. However, this level may have actually been created after the original inhabitants had left. Also, it is unclear whether this provenience was located inside or outside a structure.

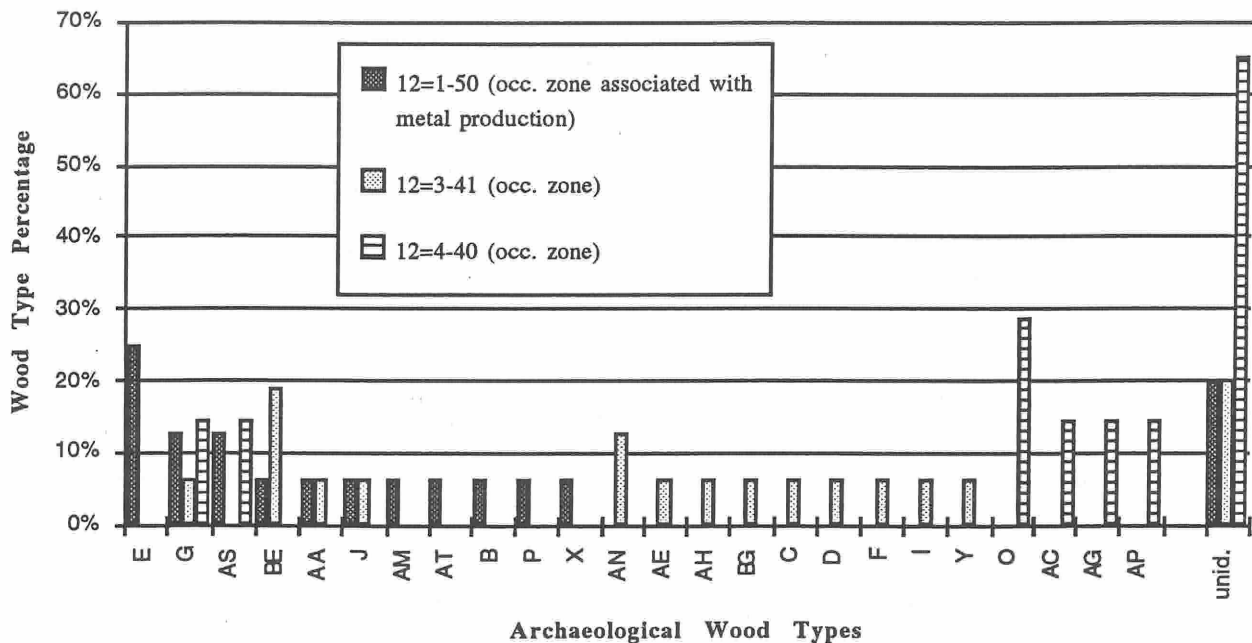


Figure 3: Archaeological Wood Types in Occupational Zone Proveniences at Valdéz 12=1-50 vs. 12=3-41 vs. 12=4-40

The charred archaeological wood fragments from Valdéz had an interesting property not seen at Potrero: many pieces recovered from this site were very hard and tended to have an outward appearance of being melted. This feature could have resulted directly from the original physical properties of the wood types

present in the sample, or it could possibly have been attributed to minerals leaching from the soil into the charred wood fragments.

Each provenience had wood types unique to its location and no single type particularly dominated any one of the examined proveniences from Valdéz. The provenience which seemed to have been associated with metal production (12=1-50) had the most types of wood also found in the other samples (12=3-41 and 12=4-40). It is interesting to note that the five types found in more than one provenience at Valdéz (G, AS ("jarilla"), BE, AA, and J) also appear with regularity at El Potrero. Keeping both El Potrero and Valdéz in mind, it appears that wood types AS ("jarilla") and AA were usually found in conjunction with one another. The fact that these two types are commonly found at both sites suggests that they were preferred or that they were widely available in the landscape. The second proposition seems likely especially since at least three types of jarilla are still common in today's countryside. Such diversity may have been related to the distance between the proveniences, the class or rank of the structures' inhabitants, the activity that was performed in the area, and/or the time of the structure's occupation. In addition, structures may have been used for unequal lengths of time. Due to the site's complex mound and patio complexes and the minimal excavations, identifying different levels as concurrent occupation was not possible.

The larger percentage of undetermined wood material in the occupation zone of 12=4-40 may have been due to the outside location of the provenience in regards to the structure. It is reasonable to conclude that those conditions outside of a structure would have been subject to harsher preservation conditions such as wind, rain, sun, and daily living activities. Yet, this archaeological wood appeared to have been over-charred. Such poor preservation could have been caused by a long charring time at low temperatures or a quickly burning but short-lived fire. There is no evidence currently suggesting that the fragments of 12=4-40 were directly exposed to a burning flame. The sample was not recovered from any immediate context of burning, such as a hearth or part of midden contents. Although this is only the beginning of a grander project, it can be suggested that Valdéz was either 1) composed of a diverse range of wood and that wood dispersion depended upon activity or social position of the inhabitant(s) within the society, or 2) the levels of occupation studied were of different time periods and varying types represent a change through time.

El Potrero de Payogasta

I compared charred woody materials of a number of different contexts at El Potrero de Payogasta (42=). I was interested in wood use during occupation levels and proveniences showing more samples from specialized activities associated with general habitation such as hearths, middens, pits, and ceramic vessels. I begin this section by comparing the fill from two ceramic vessels. One vessel was excavated from a large, circular structure (42=14-1) and the other was removed from a burial context (42=41-50). Both vessels were believed to have been covered at the time in which they were originally buried. Perhaps this example most clearly demonstrates the importance of wood study in the reconstruction of the past.

1) Charred Archaeological Wood in Ceramic Vessel Contexts:

The provenience 42=14-1 was located in the NW quarter of a fairly large, circular structure situated

between an Inka/elite residential area and an area of definite political and religious focus. The structure's southern wall had a trapezoid-shaped door which was a trait typical of Inka architecture. Furthermore, Hyslop (1990:8) suggests that this construction could possibly have been a habitation or living structure. All characteristics support the idea that this structure was used by elite members of the population. The entire vessel recovered from this structure was found buried directly below the primary occupation level and is approximately 1 meter tall.

The second vessel was discovered in a provenience located to the NE of the *kallanka* and the central religious and political center of the site (42=41-50). The vessel was noted as containing a secondary burial and was thought to have been a child urn burial placed in a cemetery. This use of urn burials was typical of the indigenous people of the area (Bennett and Bird 1960). The presence of such a burial implies that some of the residents of the El Potrero settlement were people originally from the local Diaguita community.

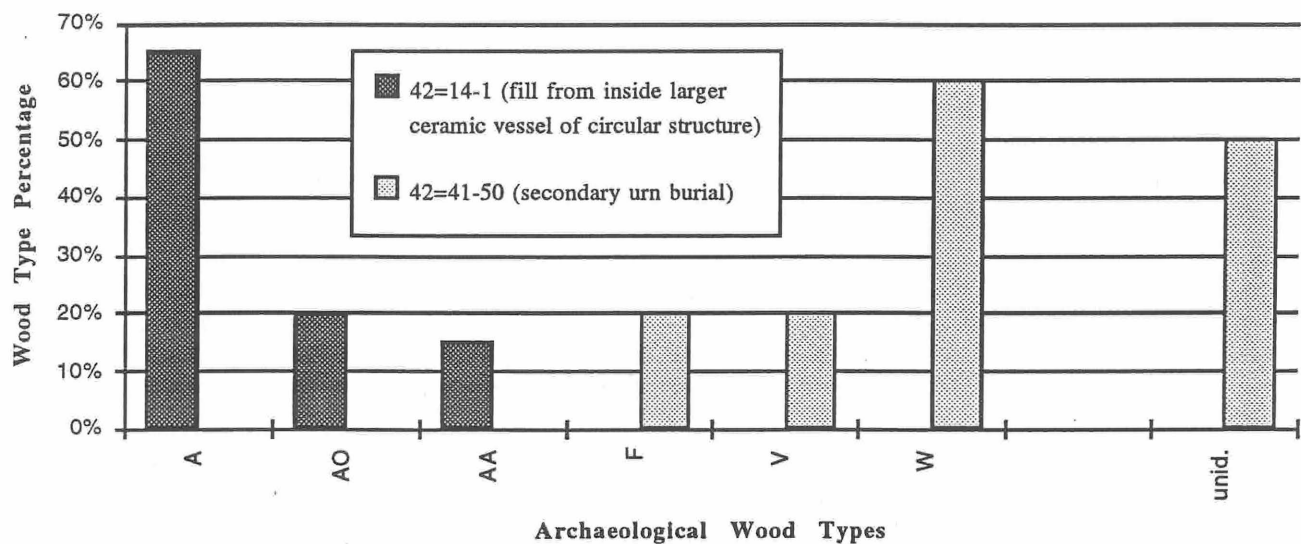


Figure 4: Archaeological Wood Types Within Two Ceramic Vessels

As can be seen in Figure 4, each vessel contained only three wood types; no one type was shared by either vessel. Considering that each of the 33 samples was examined at both sites, such a low number of types in a sample was very unique and only found in these two proveniences. In addition, each type found in these contexts had very distinct physical characteristics. For example, considering the fill of the large presumably elite habitation structure (42=14-1), I found cactus (Type A), a monocot type (AO) and type AA which originated from either a larger bush or a tree. Similarly, types F, V, and W that were found in the burial urn (42=42-50) had very discrete characteristics, but unlike the larger vessel, the burial context contains strictly hardwood species. From the woods' internal characteristics it was possible that type F may be from a denser wood such as a leguminous tree. Type W, on the other hand, was likely to originate from a very small shrub or woody plant and type V from a slightly larger growing bush or small tree. The vessel types, the differences of the provenience uses (elite habitation vs. local secondary burial), and their state of preservation (no unidentifiable charred wood fragments were viewed whereas half of the pieces found in the urn sample were

unrecognizable) are marked differences. The distinct types, discrete classes of woods (i.e. dicots vs. monocots), and different preservation states are very obvious. It is unavoidable to conclude that the wood was utilized for different purposes. They may signify religious offerings, or, considering the contents of the burial urn, wood used for cremation. The larger vessel from 42=14-1 may have been used as a storage container or an offering to the gods while the structure was occupied.

2) A Comparison of Archaeological Wood in Hearth Contexts:

In this comparison I contrasted the contents of three hearths from three different areas (42=14-1, 42=21-51, and 42=40-1) of El Potrero. The hearth provenience 42=14-1 was situated in the occupation zone associated with the large ceramic vessel discussed in the previous comparison. 42=21-51 was a hearth provenience located outside and adjacent to the door of an elite rectangular structure. This structure was in an area bordering the western edge of the ushnu-central plaza area. The third hearth provenience (42=40-1) was taken from an Inka-built circular structure located on a small rocky knoll to the west and above the main portion of the site. This provenience was practically the only area of high concentration of archaeological remains found in the structures excavated on this isolated hilltop. However, 42=40-1 was found below the structure's walls. In general, the entire area appeared to have had special use by the Inka. Very likely it was used for storage which could prove to answer why very few charred wood fragments were found in any of the occupation levels of the hilltop proveniences.

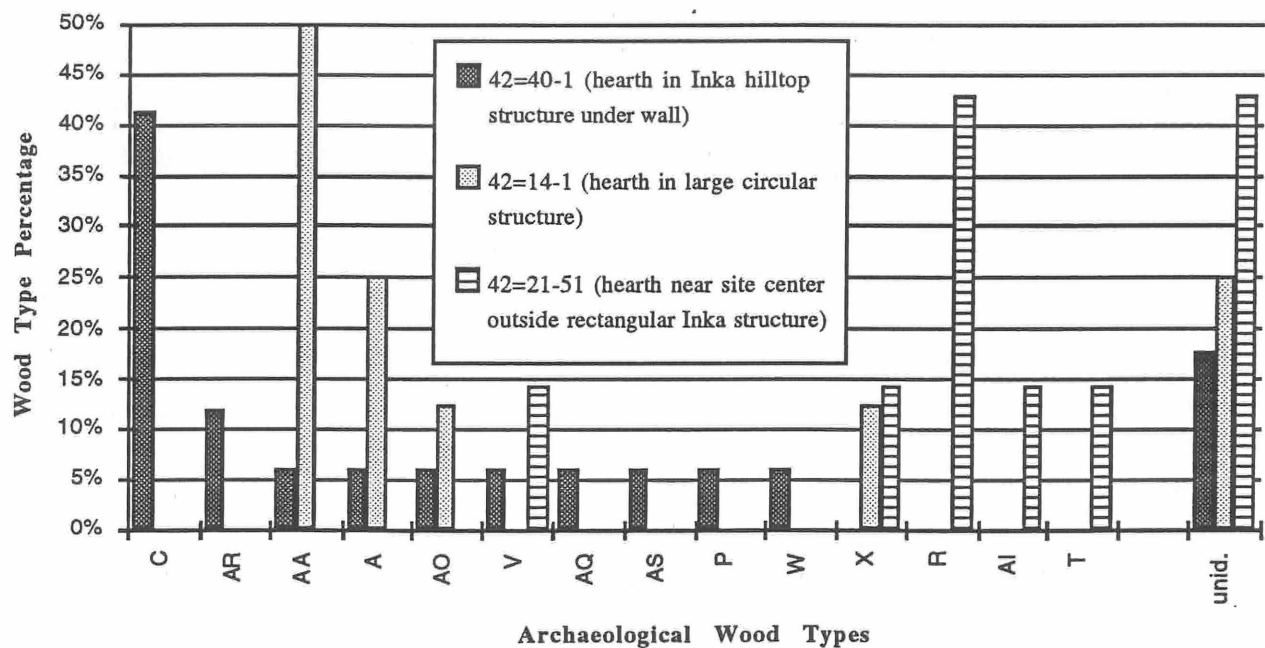


Figure 5: Archaeological Wood Types in Hearth Contexts 42=14-1, 42=21-51, and 42=40-1

As seen in Figure 5 there was a number of disparate wood types present in these three hearth contexts. Yet, those types found in the western hilltop hearth context (42=40-1) overlapped with those from the other

two proveniences, especially with the wood from the large circular structure. Types seen in the hearth contexts of the large circular structure (42=14-1) can be contrasted with those charred wood fragments recovered from the larger ceramic vessel of the same structure (see Figure 4). Type X was the only type not found in the vessel fill. Due to the poor preservation of the single X-typed wood piece, its identification was difficult. Otherwise it is possible to say that the contents of the hearth 42=14-1 were complimentary to those that were found in the vessel of a similar provenience.

The hearth located outside of what appears to have been an Inka-style structure, 42=21-51, contained many unidentifiable fragments. The very tiny archaeological charred wood fragments from the hearth outside the rectangular elite Inka structure and their state of poor preservation corresponds well with the "outside" location of the provenience. These pieces seem to have endured harsher treatment which could stem from repeated exposure to the heat of a hearth fire, daily activities such as walking over the charred wood fragments, and subjection to natural environmental conditions.

A, AA, AO are commonly found together. From Figures 4 and 5, it is possible to see that the wood in the hearth and of the vessel directly below contained almost the same types of wood. Perhaps the two provenience contexts were related and this large circular structure was not used for habitation but had a religious and/or political significance. On the other hand, the three predominant types may have signified class distinction, whereby elites had access to a specific fuel type. Yet the prominence and fairly good preservation of what was typically a delicate material--the monocot AO--tends to contradict long burning periods that are traditionally associated with hearth use. Nevertheless, the great variety of wood related to the three Inka elite structures suggested that no precise distinction was made between who used which woods in what area. Instead, the evidence seems to indicate that the nearest available source of woody material was exploited.

However, on closer examination of type T, it is possible to notice a relationship between this wood type and the area in which it was found. Only two type T fragments were found in all of the samples examined. More precisely, these two pieces are associated with the centrally located elite structure (42=21-)--one inside and one outside (Figures 5 and Figure 14). Such a relative concentration may signify a special use of this area.

The sampling of the hilltop structure of 42=40-1 resulted in a very diverse number of wood types--ten types in all. This variety of types, as shall be seen in later comparisons, is very typical of almost every provenience at both El Potrero and Valdéz. Even though the sample of 42=40-1 was taken from what has been described as a "hearth" context, the recovered charred fragments are considerably well preserved. Such good preservation and the very large volume recovered (approx. 24 l of charred materials) suggest a single use of these woody materials found in this context or a practice of regular cleaning of the hearth. However, the first hypothesis is more likely due to the fact that this hearth was located below the structures' walls. Since the materials were left in fairly good condition, i.e. there is no evidence that any materials were first cleared away before building began, it is possible that this hearth was used in some type of offering or ritual before the first foundation stones were laid. On the other hand, it may simply be the results of laborers' fire.

There were few similarities in the wood types found within these three hearth proveniences. However,

these differences may have been due in part to the availability of materials--those types appearing less frequently throughout the samples may suggest a rare species. On the other hand, such similarities may be related to much more than just availability, that is, methods of redistribution within the population, preference of certain woody materials, and the overall suitability of the wood for the purpose for which it was used.

3) A Comparison of Pit Fill Contents:

In Figure 6 I examined two pits from different parts of the site of El Potrero (42=7-50 and 42=15-90). The first pit was located in a patio near a wall of what was thought to be an elite habitation structure (42=7-50). This pit was part of what is believed to be a dump or garbage disposal area used by elite members of the Inka society. The second pit, 42=15-90, was situated directly in front of the stairs of the site's *ushnu* in the central plaza, associated with religious and/or political functions. Both pits were secondary fill and had very definite boundaries. That is to say that holes were first dug before their contents were emptied into them. Also, it appears that the *ushnu* related pit was covered before it was buried by naturally deposited soil.

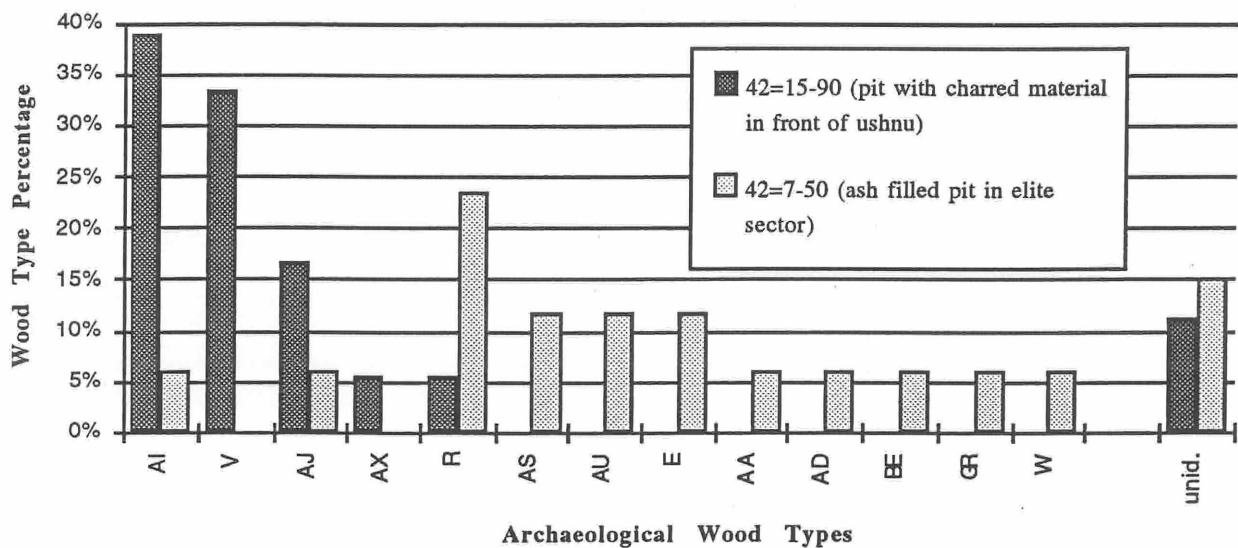


Figure 6: Archaeological Wood Types from Two Proveniences of Pit Fill 42=7-50 and 42=15-90

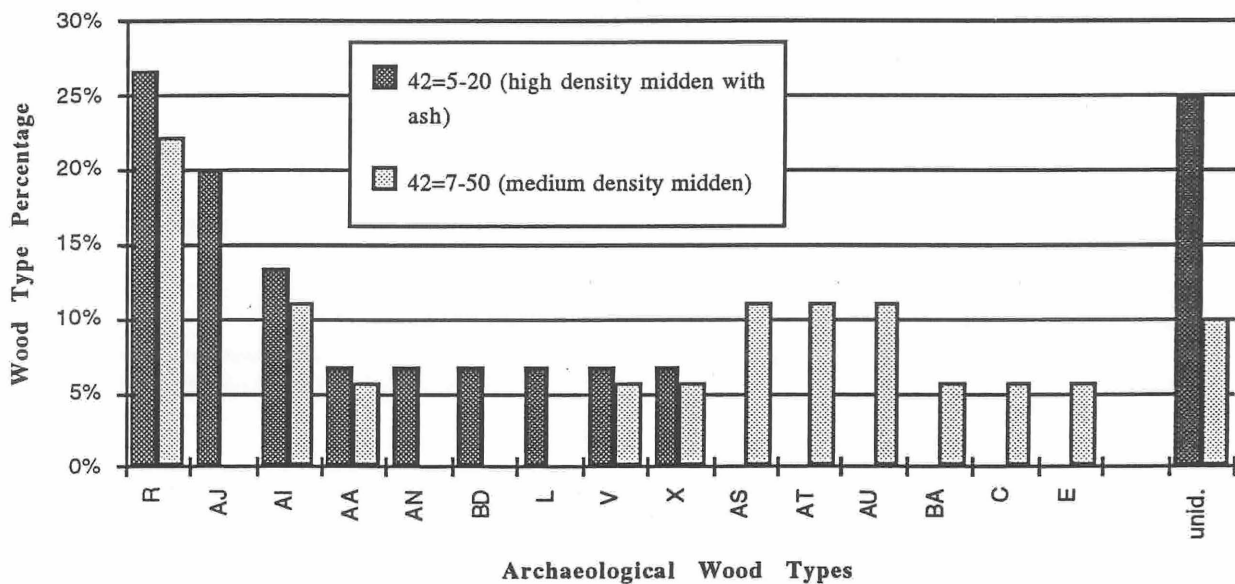
Compared to other samples, the pit outside the elite structure (42=7-50) contains a large variety of wood types. In total, there were 11 different types out of 17 identifiable fragments. This diversity seems to signify several things. First, it points to the fact that the inhabitants of the elite structure had access to a large variety of wood, for, not only were there many types recognized in this sample but it was also possible to distinguish many types seen less frequently at the site. The fact that the charred wood fragments were in fairly good preservation also alludes to the fact that wood was not exposed to long burning conditions which usually destroys the charred wood's anatomical characteristics. Thus it is possible to say that those who used this pit as a midden had access to many types of wood in large quantities. Such a statement can be supported by the high density of the charred remains as well as the relatively undamaged condition of the charred fragments. The wood for the fire was probably used only once before it was cleaned out and a separate batch of wood

was used. This apparently frequent cleaning of the hearth could be regarded as an "expensive" expenditure of wood as compared to what is readily available in the surrounding area.

Compared to other samples, pit located to the west of the ushnu consisted of an average amount of wood types. Considering its ushnu plaza vicinity, I expected that this wood use would have been considered important, and thus, reflect wood types unique only to this location. Yet, comparing the wood types present in this provenience with others collected at El Potrero they do not seem to be at all confined to this area. On the contrary, types AI, V, and R are some of the most commonly found types at the site. This may mean that Inka ceremonial practices did not demand specific wood types besides what was on hand, or perhaps, those species particularly associated with the Inka may not have been brought to El Potrero.

4) A Comparison of Archaeological Wood Types in Midden Contexts:

Like provenience 42=7-50, provenience 42=5-20 is located outside of an Inka-styled rectangular structure situated directly to the NW of 42=7-50 in what appears to be the elite sector of the site.



**Figure 7: Archaeological Wood Types in Midden Contexts
42=7-50 and 42=5-20**

Both provenience 42=7-50 and provenience 42=5-20 have very diverse ranges of taxa (Figure 7). The types common to both proveniences (R, AI, AA, V, and X) are generally the most frequently encountered types at the site. In this comparison, it is important to note the similarity of the general midden contents of the medium density midden of 42=7-50 and the contents of the ash pit in the same structure and area (Figure 6). This continuity of types supports the idea that the habitants of the structure and its associated patio had access to many types of wood as well as a large quantity. This is further upheld by the high density of woody materials in the two associated samples of 42=7-50 (Appendix B). The contents of the high density midden 42=5-20 closely resemble the pit fill near the *ushnu* (42=15-90; Figure 6) as well as the hearth of provenience 42=21-51 (Figure 5). Since both the *ushnu* and the hearth provenience were considered to be associated with

the elite society at El Potrero, such correlations are fascinating, for they support the idea that a certain class of people had access to certain valuable resources unavailable to others.

5) Archaeological Wood Types in Cultural Fill Contexts of a Single Patio at El Potrero:

In this comparison two similar patio proveniences of cultural fill were looked at (42=9-50-1 and 42=9-50-3). These proveniences were located within a larger indigenous styled enclosure but directly against (42=9-50-1) and nearby (42=9-50-3) a trapezoidal shaped building. The patio area is situated on the eastern edge of the site in an area of mixed Inka and indigenous styles of architecture.

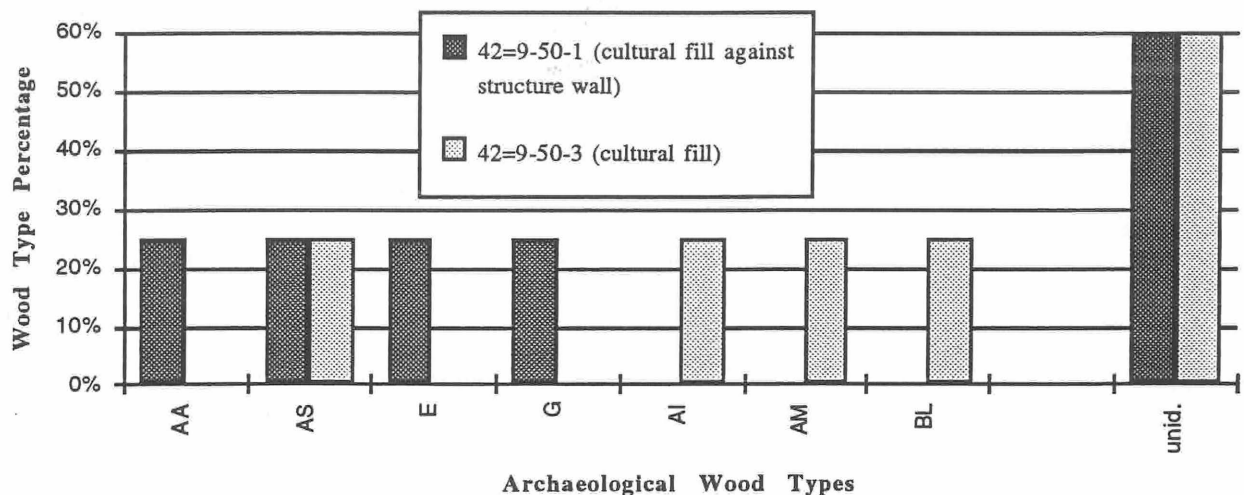


Figure 8: Archaeological Wood Types in Cultural Fill Contexts from the Patio Area: 42=9-50

Most of the types of charred wood found in these two proveniences seen in Figure 8 are common to the entire site. Yet, I did not expect to encounter the diversity of types that I did, especially considering that the patio proveniences are adjacent to one another. Instead, considering the amount of readily available woody material in the area and the general location of these two proveniences within an open patio area I expected to find many unidentifiable fragments and only two or three repeatedly seen types. On the other hand, the two proveniences were most likely located in the center of the patio activities and in the perfect location for debris to collect when the wind blew or the floor was swept. An intriguing find in the provenience in contact with the structure wall (42=9-50-3) was the presence of type AM or "molle". As well, two other proveniences thought to be associated with Inka architecture in the "elite" sector have been identified (see Figure 11 and Figure 13) along with the provenience on the western hilltop contained type AM (Figure 11). This is a tree thought to have been extensively used by the Inka and its presence could identify this area as also used by the Inka.

6) A Comparison of Occupational Zone Contexts:

A.) Plaza Proveniences: Upper Plaza in Elite Sector and Ushnu Plaza:

The comparison seen in Figure 9 is a contrast of two plaza areas in the main area of the site of El Potrero.

It involved four different proveniences from a total of two major locations: upper and lower levels of occupation in a large patio or plaza of the site's elite sector (42-4-50-1-4 and 42-4-50-1-7) and two proveniences located directly next to the *ushnu*, one to the west and one to the south.

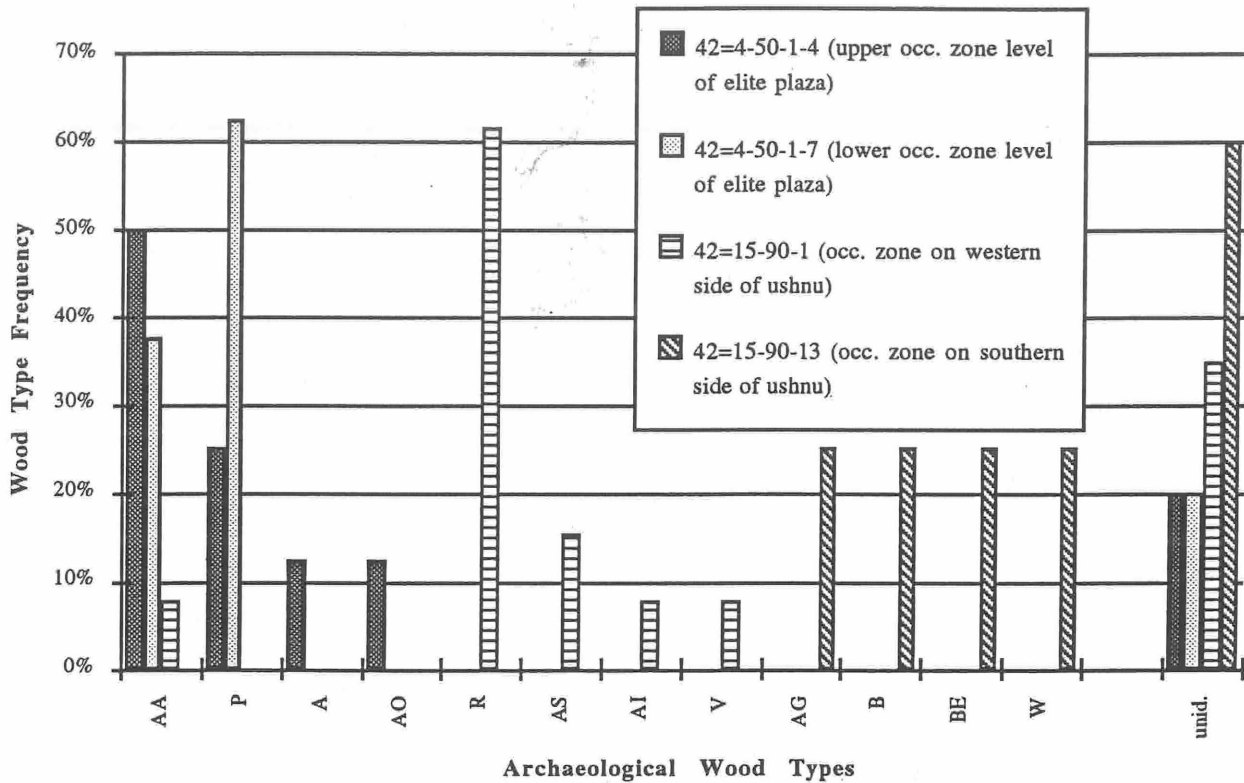


Figure 9: Archaeological Wood Types: Plaza and Ushnu Occupational Zones at El Potrero de Payogasta

Remarkable is the difference between the plaza areas and even the differences encountered between the two *ushnu* areas. The upper plaza has three commonly associated types: AA, AO, and A. Also present is type AS ("jarilla") found in almost every provenience. Although the *ushnu* types are not rare, the great distinctions between the two areas is almost unexpected. Yet, these differences can be associated with ritual or governing practices.

B.) Rectangular and Circular Structures:

In the next two comparisons I was interested in determining whether the form of the structure dictated its use. I hoped to find a clue by contrasting the wood types found within the two distinctly formed structures. The rectangular structures that were studied included two from the elite sector of the site (42=7-20 and 42=5-20) and a single *kallanka* provenience (42=17-20) (Figure 10). The three circular structures also examined included the proveniences of 42=14-1--a large circular structure situated on a slope to the south of the *ushnu* plaza, 42=40-1--a possible storage structure to the west of the site, and 42=16-1-- a small round structure near the SE edge of El Potrero (Figure 11).

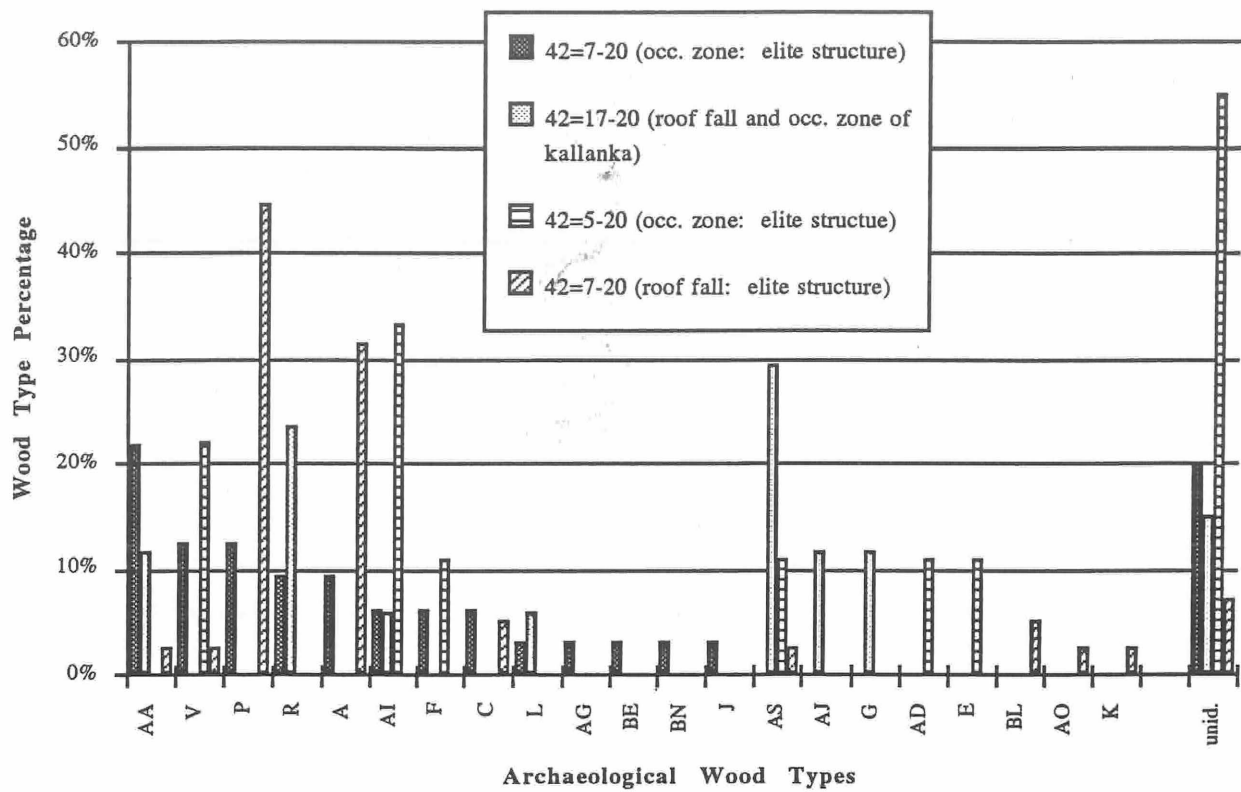


Figure 10: Archaeological Wood Types in Occupational Zone Contexts of Rectangular Structures at El Potrero de Payogasta (42=)

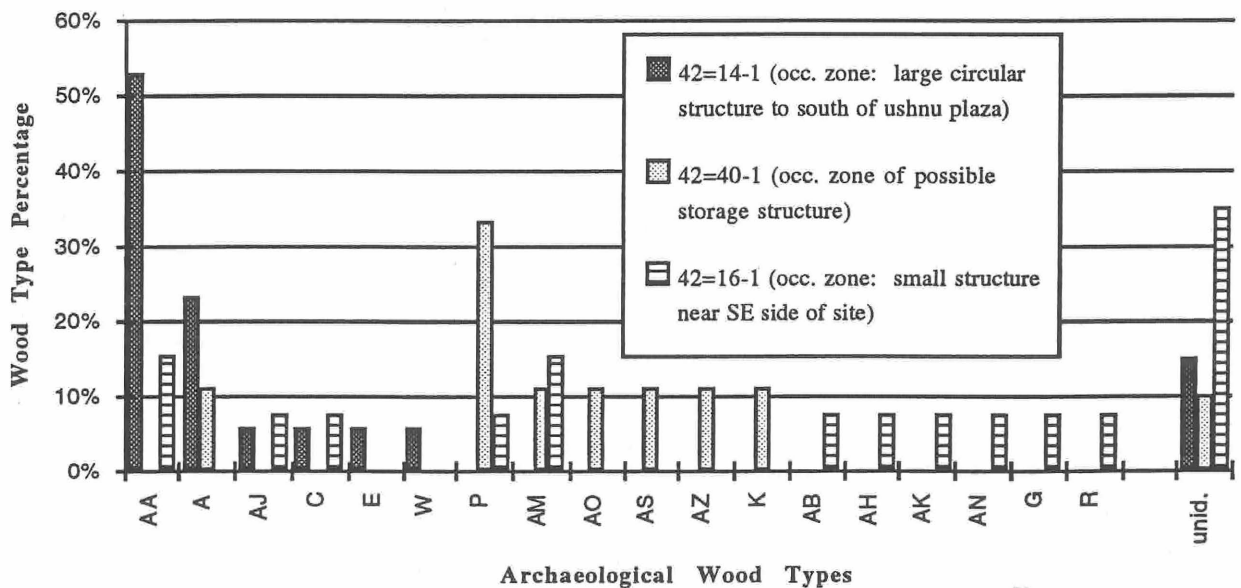


Figure 11: Archaeological Wood Types in Circular Structures of Occupational Zone contexts at El Potrero de Payogasta: 42=14-1, 42=40-1, and 42=16-1

Although nothing conclusive can be noted in regard to the contents of a structure and its relative shape, it is

possible to relate context to the type of wood use in at least one, if not more, rectangular structure (see Figures 13 and 14): 42=7-20. The remains seem to indicate that cactus wood (Type A) was used for roof construction. Although cactus was found in both layers it seems to have incompletely burned and collapsed; it is reasonable to assume that the impact of the roof onto the floor would disturb the floor materials resulting in a slight mixing of the two levels. On close inspection it is possible to recognize similarities in the types of charred woody remains of both the roof fall of the provenience 42=7-20 and the occupation zone of the western hilltop structure of 42=40-1. Here, it also seems possible that the roof of this structure had at one time fallen in if it is assumed that most structures were covered.

On the other hand, a reason that cactus was always encountered within the occupation zones inside a structure could be due to the fact that similar woody materials were used for daily activities. Although this could be possible, even today the residents of the northern Calchaquí Valley tend to reserve cactus wood for roof and door paneling. One aspect that contradicts the idea that cactus may have been used in daily activities such as fuel, was seen in the laboratory during the charring of modern cactus wood. Namely, this material burned amazingly easily and rapidly; when I unwrapped the modern pieces of cactus that were being charred, they burst into flame and after a few seconds the pieces disintegrated. This property of the cactus wood to burn rapidly and completely seemed to make it a poor choice of burning material.

All in all, it is possible to recognize that type AA was probably the most commonly used material throughout the site. Cactus also seemed to be a popular woody resource. Such a diversity in types, can once again suggest that many woody species of vegetation in the immediate area were exploited for all aspects of life.

7) Occupational Contexts Within a Single Structure Associated with Metal Production:

Similar to the comparison of adjacent patio proveniences, I wished to study how proveniences of a single structure would correlate. I compared three proveniences from inside of a rectangular structure that is associated with the production of metal (Figure 12). Although these proveniences share the same context and general location, I was surprised to see the great contrast within the interior of a single structure: very few types were found in more than one provenience. In part, such diversity could stem from the fact that this building was probably designated for a specific activity. Indeed, this occurrence may be indicated by the slight overlap of several types within the structure, such as types L, AI, R, and W; for, the central dense occupation zone is fairly close to the NW corner, and the center wall provenience directly abuts the structure's center. A hypothesis as to why the structure's three proveniences do not overlap more can be that each region of the building was reserved for a distinct activity, and thus, all areas were kept well ordered.

A probable explanation for the large percentage of unidentifiable fragments in the dense occupation zone could most likely stem from two reasons, 1) this provenience is closely situated to a hearth provenience and 2) since it was located in the center of the room, any type of material left under foot was likely to be trampled.

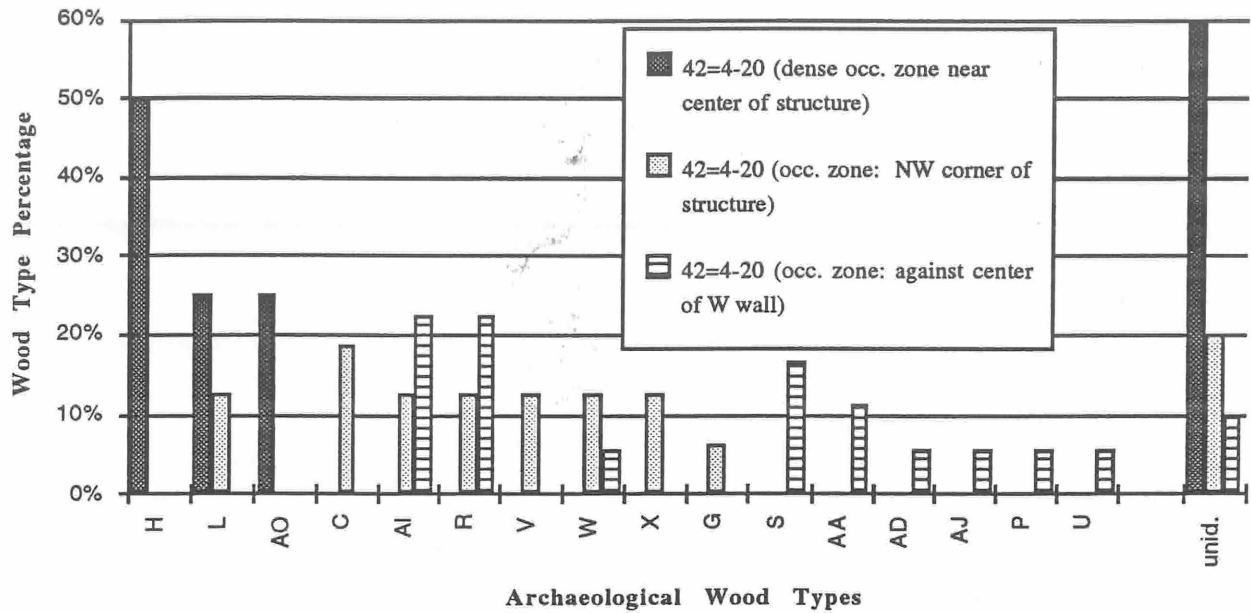


Figure 12: Occupational Contexts of Different Proveniences Within the Structure of 42=4-20

8) Inside and Outside Occupational Zone Contexts:

In this example I compared the interior and exterior proveniences of a single structure (Figure 13). This structure, 42=16-50, appears to have been a rectangular structure located on the southern edge of the area designated as an elite sector.

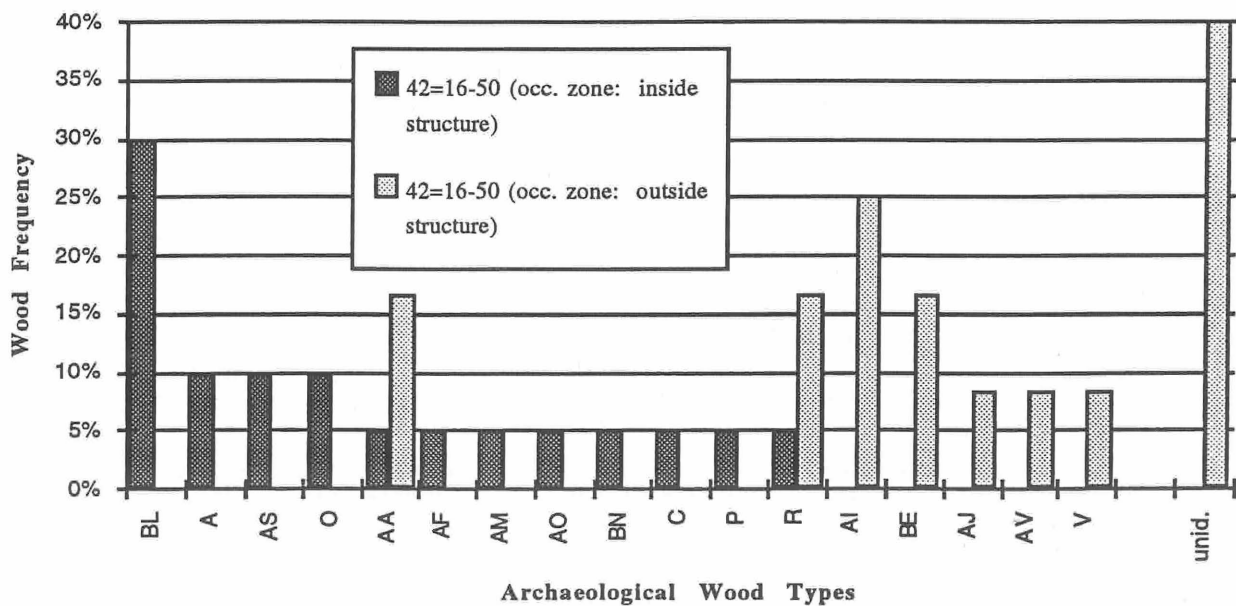


Figure 13: Archaeological Wood Types: Inside and Outside Occupational Zone Contexts of Structure 42=16-50

Once again I saw a great diversity of types within both provenience samples at 42=16-50. Only two types were found both inside and outside of the structure: types AA and R. An obvious difference in the condition of preservation was also noticed. Many of those fragments which would have been considered outside were unidentifiable. Differences could be explained by different activity areas. Cactus (Type A) was again recognized within the sample coming from the structure's interior. Its presence could signify a preferred woody material, its wide availability, and/or a collapsed roof.

9) Three Proveniences in Association:

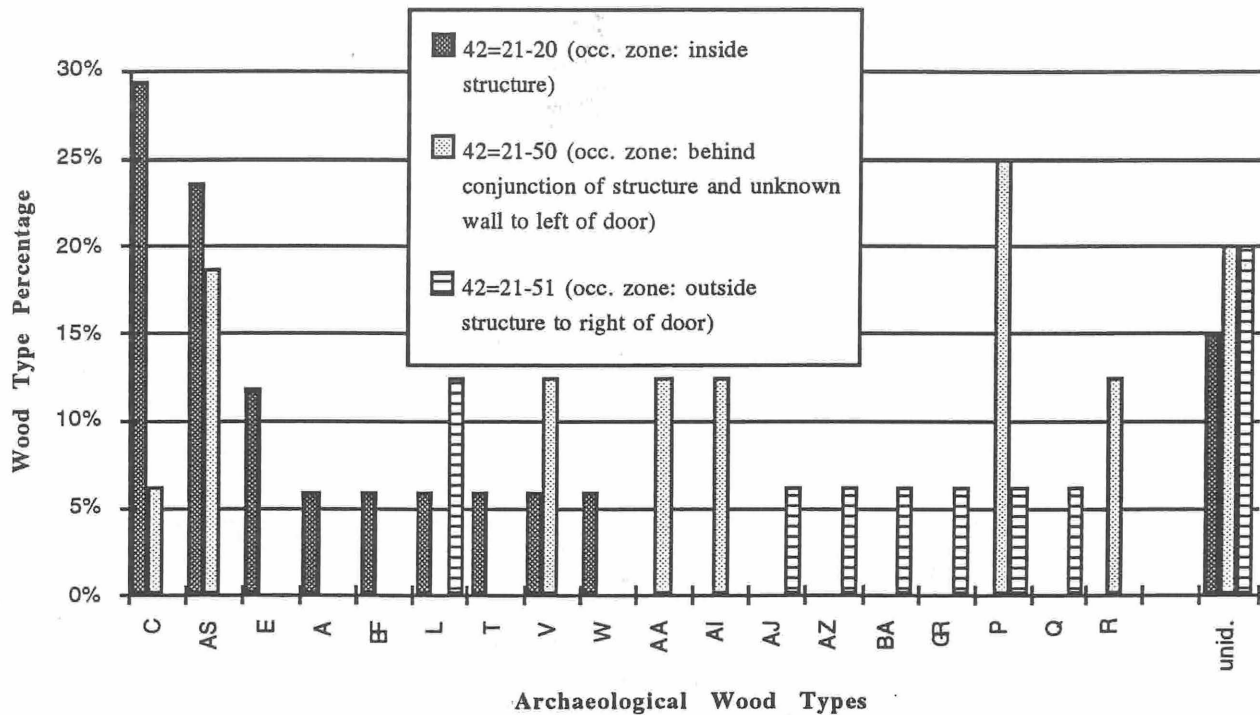


Figure 14: Three Proveniences in Close Proximity and with Similar Contexts at 42=21

The comparison in Figure 14 contrasts three occupation zone contexts from the same general area but within and outside of a single structure--similar to the comparison presented in Figure 13. As of yet, it has not been determined whether 42=21-50 is an inside or outside context. However, because types C, AS, and V were held in common by both 42=21-20 and 42=21-50, it could be suggested that the sample 42=21-50 was taken from an interior context. On the other hand, both 42=21-50 and 42=21-51 shared two wood types. Such wide a variety of types and their broad dispersal and mixture across the site made any concrete determination unlikely. Nevertheless, something interesting about this comparison is that types BA, AJ, and GR were found only in two contexts: the midden context of 42=7-50 (Figure 7) and the occupation zone 42=21-50. Also, BA and GR were found in no other sample but these two. Cactus (Type A) was once again just seen in the structure's interior.

Summary of Problems Encountered:

As I examined the charred archaeological wood material, I encountered several difficulties that did not arise during the examination of the modern wood. For example, due to the poor state of preservation, the archaeological charred pieces often shattered, turning the wood fragment into crumbs. Another problem was that a few archaeological fragments were in such bad condition that it was impossible to discern any specific physical characteristic. In such cases, I recorded the condition of the piece on a note card before continuing with the next piece: it was impractical to draw pieces that were either deformed or little more than crumbs. In addition, the description of each charred wood fragment was incomplete, insofar that an accurate identification scheme requires a multi-sided approach is used in conjunction with either slides of thin-sectioned wood or SEM (Scanning Electron Microscope) pictures. Also, after trying to organize a modern reference collection for identification purposes, it became apparent that because the modern wood collection notes were incomplete I was going to have difficulties in exact identification. The modern collection samples needed to be given scientific names.

In regards to the microscope analysis, the use of varying magnifications frequently emphasized different wood characteristics for the same sample making a single piece look like a distinct type at every magnification level. In order to compensate for this discrepancy, I described and/or drew a single wood type at various magnification. The identification of both charred wood was further complicated since many of the examined fragments did not exceed the length and width of 2 mm. Although I worked very carefully, there are some types with very similar characterizing traits. If the charred fragments were especially small, only a limited portion of the wood's complicated physical structure could be seen. Such an incomplete view could mean an incorrect identification, especially since the physical characteristics of an individual wood type can vary immensely depending on from where the piece originates (e.g. early or late wood). Although certain characteristics did seem to distinguish certain types of wood, factors such as irregular growth, poor preservation, and the plant's stage of growth when it was originally charred could also have drastically altered the distinguishing characteristics of the various wood types. In some cases, the problem of incorrect identification may be resolved with a more accurate and detailed record of each piece, for example, a SEM photograph.

Conclusion:

The objectives of comparing the charred wood contents of 33 different provenience samples from the archaeological sites of Valdéz and El Potrero de Payogasta were to ascertain (1) whether differences and/or similarities between the material recovered from the two sites could be ascertained and (2) whether various areas of a site are likewise reflected in variations of the charred plant remains collected from distinct proveniences. Ultimately this study can increase our knowledge about the past environment, the movement of materials (i.e. woody plant materials) into and out of the area, the availability of materials to different groups of people, how past cultures manipulated their environment and the plants found growing there, and cultural preferences and beliefs. Accordingly, I contrasted the contents of an indigenous and Inka constructed site