4-2004

The role of geography in the development of Paquimé: a cost-surface analysis to determine patterns of trade for copper bells from western Mexico into the southwestern United States

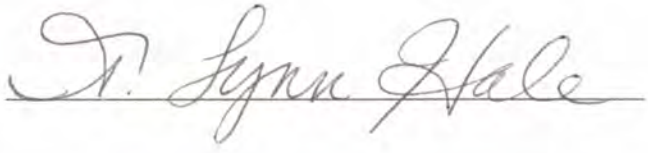
Lynn Hale

THE ROLE OF GEOGRAPHY IN THE DEVELOPMENT OF PAQUIME: A COST-SURFACE ANALYSIS TO DETERMINE PATTERNS OF TRADE FOR COPPER BELLS FROM WESTERN MEXICO INTO THE SOUTHWEST UNITED STATES AD 800-1250

Lynn Hale

NOTICE TO BORROWERS

In presenting this thesis as partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the library of the university will make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish from this thesis may be granted by the author, by the professor under whose direction it was written, or by the Dean of the College of Arts & Sciences. Such quoting, copying or publishing must be solely for scholarly purposes and must not involve potential financial gain. It is understood that any copying from or publication of this thesis that involves potential financial gain will not be allowed without written permission of the author.



All dissertations and theses deposited in the Georgia State University Library may be used only in accordance with the stipulations prescribed by the author in the preceding statement.

The author of this thesis is

Lynn Hale
215 Franklin Farms Circle
Fayetteville, GA 30214

The director of this thesis is

Dr. John Kantner
Department of Anthropology
College of Arts & Sciences

The Role of Geography in the Development of Paquimé:
A Cost-Surface Analysis to Determine Patterns of Trade for Copper Bells from Western Mexico into the Southwest United States
AD 800-1250

A Thesis

Presented in Partial Fulfillment of Requirements for the Degree of Master of Arts in the College of Arts and Sciences Georgia State University

2004

by

Lynn Hale

Committee:

Dr. John Kantner, Chair

Dr. Frank Williams, Member

Dr. Jeremy Crampton, Member

April 23, 2004
Date

Dr. Kathryn Kozaitis
Department Chair

DEDICATED TO

John Hale and Elaine Hallisey
for their infinite patience and unwavering support.

- and -

Dr. John Kantner
Dr. Frank Williams
Dr. Jeremy Crampton

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AZ	Arizona
CO	Colorado
DEM	Digital Elevation Model
EROS	Earth Resources Observation System
ESRI	Environmental Systems Research Institute
GCS	Geographic Coordinate System
GIS	Geographic Information Systems
GTOPO30	Global 30-Arc-Second Elevation Data Set
NM	New Mexico
USGS	Unites States Geological Survey
UTM	Universal Transverse Mercator

The Role of Geography in the Development of Paquimé: A Cost-surface analysis to determine patterns of trade for copper bells from Western Mexico into the Southwest United States AD 800-1520

Chapter 1: Introduction

Statement of Research Problem

Paquimé is a pre-Hispanic site in the northern Mexican state of Chihuahua. The chronology for its development begins with an understanding of the events of the Medio period, AD 800-1520. This period is divided into Phase I (AD 800-1250) and concludes in Phase II (AD 1250-1520). During Phase I, Paquimé is little more than a village in the middle of the Chihuahuan desert. In the span of a few years near the beginning of Phase II, Paquimé exploded onto the international scene, exhibiting characteristics of both Mesoamerica and the American Southwest.

Archaeologically, Paquimé is a site rich in architecture, public works, and artifact assemblages. Unfortunately, archaeologists disagree about the activities that caused these features to be at Paquimé. Despite years of work there, it is still unclear to archaeologists why Paquimé developed more than other communities in the region. Paquimé may have participated in the trade network between what is today Mesoamerica and the American Southwest because of its convenient geographical location. The precise role of Paquimé in the long-distance trade routes is not known, and the level of its importance is in dispute.

Why did Paquimé grow into one of the largest pueblos of the Southwest? Exchange of exotica between what is now the United States and Mexico may have been a factor in the growth of Paquimé. The movement of goods through exchange networks provided residents of polities like Paquimé with access to foreign-produced 'elite' goods. The movement of

these goods through space likely occurred along the path or paths of least resistance – the trade route(s) that offered optimum movement with minimum effort. It also provided opportunities for Paquimé to grow and develop through interactions with other polities.

This research project has been designed to utilize a Geographic Information Systems (GIS) to elucidate the impetus for the development of Paquimé, a pre-Hispanic polity that developed in the northern Mexican state of Chihuahua during Phase II of the Medio period. Little is known about Paquimé, due to the limited archaeological activity undertaken there. From 1958-1961, Charles Di Peso conducted field work at the site, and wrote a multi-volume work (Di Peso 1974) which described the work there. In these volumes, Di Peso developed a lengthy and detailed history for Paquimé, which has fallen under intense scrutiny for some unsubstantiated and somewhat unorthodox interpretations of the archaeological record. A decade and a half later, another archaeological project was undertaken at Paquimé (Whalen and Minnis 2001). This project differed from the first in that it focused on survey of the outlying area, or periphery, in order to determine the scope of Paquimé's influence.

In the intervening years, many archaeologists and anthropologists undertook the task of re-examination and re-interpretation of Di Peso's long accepted vision of Paquimé, the artifacts, and the site. Despite questionable interpretations, Di Peso was not entirely wrong in his assumptions about Paquimé. However, re-examination of the data reveals that Paquimé was not quite the "Holy City" he had envisioned. Paquimé was smaller and less influential than he had supposed, but did benefit from Mesoamerican influences in the form of grand architecture, ball courts, and exotica such as copper bells, seashells, and macaws. Paquimé was culturally enriched through its ties to the American Southwest, a fact which Di

Peso overlooked (or ignored), as many have, due to modern boundaries between the United States and Mexico.

Context of Research Problem

The architectural core of Paquimé is made up of several multi-story structures built around courtyards as well as several earthwork mounds and ballcourts. At its apogee, Paquimé grew to more than 1,500 rooms. The core zone around Paquimé's center appears to extend approximately 30 kilometers, or "about a day's walk" (Whalen and Minnis 2000:175). The distribution of prestige goods throughout the periphery of Paquimé is thought to reflect a regional system encompassing approximately 130 kilometers from the primate center, a situation that closely resembles sites of the American Southwest, such as Chaco Canyon (Bradley 1993:125, Whalen and Minnis 2000:175, Whalen and Minnis 2001:3).

Paquimé has remained an ambiguous part of the archaeological record. Its participation within a larger trade system is apparent by the presence of 'grand architecture', the occurrence of ball courts and mounds reflecting Mesoamerican influences, and quantities of exotic goods. Developing into a major polity by the 14th century, the impetus for the growth of Paquimé is not clearly understood. Theories that have been developed to explain the growth of Paquimé cite political and capitalist activities as the thrust for development. Determining possible trade routes through cost-surface analysis is important because it will provide a foundation for development of further hypotheses concerning the growth and development of this particular polity on a larger scale.

Paquimé had been misidentified by Charles Di Peso as a Mesoamerican 'outpost' because of its location and architecture. Upon closer examination by Bradley (1993, 2000),

Graves and Spielmann (2000), and Whalen and Minnis (2000), Paquimé is indeed more closely related to the pueblos of the American Southwest than to the Mayan polities of Mesoamerica. The political organization of Paquimé was not centralized, as Di Peso posited. The trade goods in Paquimé are religious paraphernalia used by members of the Katsina cult in the Southwest. Archaeologically, these items are not prominent in Paquimé until after their inclusion in a wider trade network. This indicates that people in Paquimé were aware of Southwestern religion, and acted as sources for their religious paraphernalia in the last half of the Medio period. An issue that has caused a problem in the evaluation of the pueblos is the modern border between the U.S and Mexico. Because Chaco Canyon is located in what is now the United States and Paquimé is located in what is now Mexico, there appears to have been a division in the way in which archaeologists deciphered the artifacts and architecture of the two. This is not to say that they are identical, but to point out the similarities that have, until recently, been overlooked. Another factor contributing to the confusion is the outward appearance of Paquimé and its resemblance to Mesoamerican architecture. Some walls remain standing 10 meters high, a fact that led archaeologists to believe that such grand architecture was the result of a highly centralized government, one imported into the region by the *pochteca,* a group of Aztec "itinerant militarist merchants."

The impetus for the development of Paquimé is unclear. It is possible that because of its location on existing trade routes, enterprising people from Paquimé took advantage of trade connections with people outside of their area. These trade connections would have allowed foreign goods and ideas to flow into Paquimé as local goods were traded out. This theory could explain the southwestern-style political development and Mesoamerican influence. Therefore, I hypothesize that

Paquimé developed as a large polity due to its geographic location along established trade routes between Mesoamerica and the American Southwest.

In order to test this hypothesis, it will be necessary to identify the likelihood that trade routes between Mesoamerica and the Southwestern United States passed through Paquimé. I chose to use a cost-surface analysis to test the hypothesis that Paquimé flourished as a result of its proximity to established trade routes. This was done by mapping the movement of copper bells between their sources in West Mexico into the Southwestern United States. I expected to find trade paths which pass through Paquimé during Phase I (AD 800-1250) which would ultimately lead to its fluorescence during Phase II (AD 1250-1520).

Chapter 2: Literature Review

Background

Located in the northwestern Mexican state of Chihuahua, some 130 km southwest of modern Juarez, Paquimé is "one of the largest prehistoric or protohistoric pueblos known" (Whalen and Minnis 2000:168). Its impact on local economy and importance as a long-distance trade center has long been realized, but not fully understood. Paquimé (Pa ~ *Big*, Ki ~ *House*, Me ~plural), the Nahuatl name for the pre-Hispanic polity also known as Casas Grandes, is variously known throughout the American Southwest as *Patki* (Hopi), and *Caquime* (Zuñi) (Di Peso 1974:2:295). Paquimé, by any name, fluoresced in the Medio period, roughly 13th through mid-15th centuries AD (Whalen and Minnis 2000:168).

The original model proposed by Charles Di Peso in the last quarter of the 20th century used cross-cultural comparison of Paquimé with Mesoamerica based on the type and quantity of archaeological artifacts found at Paquimé. Di Peso's model developed around the concept that Paquimé was a Mesoamerican 'outpost' and was based on Wallerstein's World Systems Theory. This model explained the presence of monumental architecture and Mesoamerican features such as ballcourts and platform mounds, along with "large quantities of imported exotica" (Di Peso 1974:2:293). Through cross-cultural comparison of social, economic, and religious data, archaeological observation, and ethnographic analysis, he articulated a past for Paquimé that was largely accepted by the archaeological community. However, recent analysis and further evaluation of the site and artifacts has revealed errors in Di Peso's hypothesis.

In this model, Paquimé was a community created by the *pochteca*, who imported Mesoamerican sociopolitical and economic systems, installed craft guilds, and subjugated

"satellite communities." This was done in order to control long-distance trade networks from the Pueblo societies of the Southwest down through Mesoamerica (Whalen and Minnis 2000:170). Because of their highly centralized political system, the *pochteca* were able to organize a large labor pool to build the monumental architecture and other large-scale features of Paquimé. The quantities of 'exotica,' or non-locally produced goods, indicated the importance of Paquimé on the long-distance trade route. The tangible archaeological remains seemed to bear up Di Peso's theory of development at Paquimé (Whalen and Minnis 2000:169).

Upon closer inspection, there are some elements of this model that detract from it. Most of the model depends upon the theory that the *pochteca* brought a centralized form of government to Paquimé. Further investigation reveals the probability that a factional, indigenous type of government existed. For example, the huge quantities of shell (over 3 million pieces) found at Paquimé led Di Peso to believe that jewelry and other crafts were created at large, localized workshops. The archaeological record reveals that shell was worked over a wide area of Paquimé, in smaller, residential workshops with varying levels of productivity (Kantner 2003:21, Whalen and Minnis 2000:175). This indicates that the leaders of Paquimé were factional, and that a non-centralized form of government existed. A centralized form of government would be reflected in centralized, formal workshops in the architectural core.

Also, presumably labor-intensive projects such as platform mounds, water works, and ball courts reflect localized production, not large-scale centralized production. It was previously thought that it would take a centralized form of government to coordinate the resources to build the 18 earthworks found at Paquimé. However, the mounds at Paquimé

contain less fill by volume than the mounds of Chaco Canyon or the Hohokam (Whalen and Minnis 2000:171). These less voluminous earthworks would not have required the organization of a great number of people to erect them. It is conceivable that they were built at the behest of factional leaders. The variation of size and shape (some are mounds, others are geometric shapes, and one is a bird effigy) indicate that a single, centralized government did not build them. As with other elements of public architecture, they may have been constructed by local factions as evidence of localized power or authority (Whalen and Minnis 2000:171). Extensive irrigation around Paquimé was seen as an engineering effort to control flooding of the rich alluvial plains. Careful mapping of the water works reveals that they are clustered in smaller areas as an attempt to control erosion and runoff of valuable land (Bradley 1993:123).

Study of the Viejo Period (AD 700-1060) reveals that Paquimé had none of the characteristics that would eventually make it an important regional primate center. Paquimé fluoresced at a time of change and flux for the Southwest. Its development coincides with the large-scale movement of people throughout the Southwest as ecological changes forced them to relocate to areas that could sustain them (Kantner 2003). This upheaval was endemic of the aggregation of people into heavily populated Western Pueblo regions. Results of this aggregation are the development of new ceramic styles, ritual, and religion. As previously dispersed people began to congregate in heavily occupied areas, styles and ideas begin to merge. One group who were greatly affected were the Mogollon, ancestors of the Puebloans who lived in the Mogollon Highlands of New Mexico. The Mogollon lived first in pit houses, and then moved above ground into the large rambling pueblos which have come to characterize the landscape of the Southwest (Kantner 2003). As this group migrated into

heavily populated regions, they intermingled with the Anasazi to form a new, socially and archaeologically distinct group known as the Pueblo (Kantner 2003). The development of a new religious order known as the Katsina cult also occurs during this time. Another group affected at this time were the Hohokam. They lived in above-ground houses along the river valleys of southern Arizona, created distinctive pottery, and collected decorated shell for personal ornamentation. However, from the time that Paquimé became a major player in the greater regional exchange system it appears that the Hohokam did not participate in this particular sphere, preferring instead to procure their own goods through other means, perhaps maintaining previously established networks.

At this time, both Mesoamerican and Southwestern styles are introduced into Paquimé. Ball courts and mounds begin to appear, and the surge of exotic goods begins to make its way into Paquimé's warehouses. Because of its geographical location between two dominant cultures, Paquimé received, and even embraced, ideologies, technologies, and trade goods from both northern and southern sources. The sphere of exchange for macaws, copper bells, and shell ornaments from Paquimé into the American Southwest appears to coincide with the Katsina religious system in the Western Pueblo. Bradley attributes this to the movement of exotic goods following mate-exchange alliances throughout the Western Pueblo area (Bradley 2000:181).

The architecture at Paquimé indicates that the population there had begun to grow, and possibly reach the point at which society becomes complex and positions of leadership tend to emerge. However, the development of complex leadership stratification takes time, and the archaeological record indicates that Paquimé had not developed to that point during the Medio Period. It would appear that Paquimé was experiencing a volatile time in its

development as factional leaders attempted to assert and sustain power. This level of unstable, weak political organizational development in society is termed "midlevel" or "intermediate" (Whalen and Minnis 2000:176). The Medio period of Paquimé is characterized by a change from a small-scale, heterarchical polity, in which a leader became powerful in a specific situation, to one of factionalism and newly developing leadership roles. The growth of the population may have required a change from a heterarchical society to one that allowed for leadership on a more permanent basis. This argument is based on cross-cultural models that recognize population growth as an indicator of leadership development (Graves and Spielmann 2000:46, 48).

Methods for obtaining power would vary according to the individual who sought it. Among these methods are distribution of prestige goods, marriage alliances, and feasts. The presence of several large roasting pits within a day's walk (about 30 km) from the center of Paquimé indicates that would-be leaders 'wined and dined' potential supporters. Because "emergent leaders lack[ed] comprehensive coercive powers characteristic of highly developed, complex societies," their power was limited (Graves and Spielmann 2000:46, Whalen and Minnis 2000:176).

Therefore, Paquimé did not develop as a Mesoamerican outpost, as posited by Charles Di Peso. Current research indicates that Paquimé had grown to a level which typically leads to political factionalism. The people who wanted to procure powerful positions within Paquimé society developed long distance trade networks that included West Mexico, Mesoamerica, and the American Southwest. While Paquimé experienced growth, the people of the Southwest were reacting to climatic changes, which caused them to relocate into areas which could sustain them. This relocation resulted in the development of new

ideas, religions, and even social groups. The needs of the new Katsina cult were met by those in Paquimé who could procure the paraphernalia necessary to their rituals. As Paquimé traded goods with outlying partners, they in turn acquired knowledge about architecture, religion, and politics.

Theory

Introduction to theoretical perspectives

Theory "directs our attention to particular features of social behavior, and suggests connections between what we observe and hear" (Layton 1997:3). For anthropologists, theory exists to guide understanding in the ways of human activities within a particular culture, past or present. It gives us a vantage point from which to consider what we witness, or in the case of archaeology, what has been left behind. Culture guides the political agent, who uses his/her emic knowledge of the culture in order to manifest changes within that culture (Blanton et al. 1996:2). Because the emic view of prehistoric society is missing, several theories have been developed in response to the query of how power developed in mid level pre-Hispanic societies. I will use Wallerstein's World Systems Theory and Blanton et al.'s Dual Processual Theory to discuss the development of Paquimé.

World System Theory

The statements Di Peso made in regards to the history of Paquimé were guided by a theory developed by Immanuel Wallerstein known as the World System Theory. This theory was designed to interpret and explain the complex networks of exchange over a wide area, involving large numbers of people. This theory is especially appealing to those who want to

consider the 'big picture' because it is based on long-term historical developments. Recognizable trends lasting from 150 to 300 years illuminate shifts in the structure of an economy. In fact, these trends are considered fundamental for the development and re-creation of the socio-economic cycle (Hopkins and Wallerstein 1982:54, Whitecotton and Pailes 1986:185). For those studying the intricate web of social interaction in Mesoamerica, World System Theory aided the interpretation of the organization of a diverse stratified system of exchange. The components of the World System Theory allow for inequalities between and among the members of the system. Unlike an empire, which is dominated by a single state, the world system is based on a capitalist world economy, in which states compete for power through the control of the distribution of goods (Hopkins and Wallerstein 1982:49, Carmack et al. 1996:83).

Organized spatio-politically, the world system consists of *core zones*, or areas with the greatest influence and highest organization. It is the ability to harness production and distribution of non-subsistence goods made in the periphery, known as exotica or "preciosities," which gives the core zones power (Whitecotton and Pailes 1986:187). Carmack identifies "gift-giving, military threat, outright conquest and tribute demands" as mechanisms of control (Carmack et al. 1996:84). Adjacent to the core zones are the *peripheral zones* of socially dominated areas that fall under the jurisdiction of the core, which provide the raw materials and non-subsistence goods for core consumption. Finally, there are *semi-peripheral zones*, areas of equilibrium in which activities of both the core and periphery are conducted. According to Wallerstein, it is the merchant activities of the semi-peripheral zones which are necessary to the function of the core and periphery (Hopkins and Wallerstein 1982:47). It is a characteristic of the system that these three components be

'non-egalitarian,' yet the functions of each are fluid, and the activities in each may overlap to some degree. Therefore, activities of the core may occur in the periphery; conversely, peripheral activities may occur in the core (Wallerstein 1982:93).

Beyond the boundaries of the world system are the *frontier peoples*, who hold little or no value or interest for the core, because they are generally widely scattered and largely politically unorganized (Carmack et al. 1996:85). The roles and boundaries of the core, periphery, and semi-periphery are not rigid; in fact, as part of the World System Theory's cyclical nature, these roles may be reversed over time (Hopkins and Wallerstein 1982:42).

Application of World Systems Theory to Paquimé

In its earliest Phase I incarnation as a small, egalitarian polity, Paquimé may have been considered a periphery or even frontier to a core zone such as Chaco Canyon or the Maya of Mesoamerica. However, over the course of time, it grew and developed through the accumulation of trade partners and the control of macaw feathers, shell ornaments, and copper bells. Paquimé had served as an outlying periphery or frontier. By the end of the Medio period, it developed into a powerful peripheral "distribution center" central to the trade of preciosities between West Mexico and the Southwest (Di Peso 1974:6:401).

The archaeological record indicates that there were several highly organized polities in the American Southwest and that Paquimé may not have been solely reliant on a Mesoamerican core zone. While some interaction with Mesoamerica is evident through the existence of Mesoamerican-style architecture such as effigy mounds and ball courts, there is also evidence of Southwestern influence in Paquimé. The archaeological record also reveals that goods from the American Southwest such as turquoise and Gila and El Paso

Polychromes were exchanged along with copper products from West Mexico, shell, and macaw feathers through Paquimé during Phase II (Bradley 1993:126, Whalen and Minnis 2001:40). Under Wallerstein's World System model, Paquimé may have benefited from participation within a larger world system from the frontier of the American Southwest and Mesoamerica. The World Systems theory, as applied to Paquimé, treats the activities of northern Mexico as well as the Southwest as core zones. While Paquimé may have originally fallen within the jurisdiction of larger, more highly structured politico-economic polities, the cycle of political and economic activities and systems of exchange brought it into the forefront of pre-Hispanic pan-American trade. During Phase I, trade routes between Mesoamerica and the American Southwest may have passed through a small village which subsequently developed into a large exchange center in Phase II known as Paquimé.

Paquimé is seen as an example of a 'primate center' or 'core' because it is the locus of the bulk of luxury goods in that region, and therefore had control over the distribution of these items. Sporadic users of shell ornaments in the Viejo period (AD 700-1060), Paquimé tremendously increased production of shell ornamentation in order to supply the Katsina cults of the Southwest with the necessary macaw feather, shell, and copper ornamentation. Paquimé is not the *only* site with a significant number of marine shell objects. There have been other sites in the Southwest that contain rather large shell assemblages, but Bradley identifies them as "large, heavily populated sites that have well-developed ritual and social protocols" (Bradley 2000:175).

Dual Processual Theory

The foundation for Dual Processual Theory lies in two tenets of theories developed by Smith and Marx. First, exchange is the impetus for social interaction. The production of goods for exchange, according to Marx, relied upon the development of society, because it required exchange partners. Second is the concept that people will intentionally produce a surplus of goods. The intentional over-production of goods for exchange is a source of power (Layton 1997:9-10).

Dual Processual Theory was formally introduced to archaeology (and anthropology) by Richard Blanton and colleagues (1996). Much of it is based on earlier work done in the 1970s by Flannery (1972), Service (1975), Wright and Johnson (1975). Also contributing to the theoretical framework are Giddens (1984), Bourdieu (1977), and Brumfiel (1992). This theory is concerned with more than social or political change or cultural determinism. Blanton and colleagues take into account the effect of culture on the processes that induce change. They assume that people will strive to hold positions of power and that this goal can ultimately be reached through collecting "wealth, status, or power" (Blanton et al. 1996:2).

Dual Processual Theory is a dichotomous theory which delves into the development of power through exchange. There are two types of strategies. The *exclusionary* or *network* strategy deals with the individual's ability to gain power and prestige. The second component of Dual Processual Theory, known as the *corporate* strategy, involves several agents who act on behalf of the community as a whole.

The network strategy is designed to address questions regarding political structures and power systems and their relevance to the archaeological record. For instance, how does

an individual in a pueblo gain power? This task is accomplished by gaining control of production or distribution of elite goods or exotica (Graves and Spielmann 2000:48).

Adam Smith posited, "The power conferred by the ownership of money is the power to buy other people's labor" (Layton 1997:9). By replacing 'money' with 'exotica,' this statement holds the same meaning for Dual Processual Theory. This option is available to any household with ties outside of the local community. Power is gained through socioeconomic obligations between individuals or groups (Graves and Spielmann 2000:48). It "derives power from individual networks of leaders" who leverage their power on portable wealth and ritual (Mills 2000:10-11). This strategy ultimately benefits the individual, who gains monopolized access to exotica (non-locally produced goods) through long-distance kinship ties. 'Expansive kinship linkages' that connect an individual to a wide group of people are regarded as more stable, and therefore better, sources of power (Douglas 1995:250-2). This concept of 'personal dominance' has been explored in other areas of political development, and may be likened to the system of vassalage of feudal Europe (Blanton et al. 1996). However, it is the "marked increase in the intensity of long-distance exchange… that suggests an avenue through which individuals could acquire prestige and power" (Graves and Spielmann 2000: 47).

The network system is theoretically open to any individual or household who is able to establish a network. It is an "open, fluid, competitive activity…" that encourages rivalry in the attempt to garner power and recognition within the community (Whalen and Minnis 2000:174). The outcome of this strategy is the development of a competitive and sometimes volatile society (Blanton et al. 1996:4, Graves and Spielmann 2000:48). Power was ultimately achieved and maintained through patrimonial rhetoric and prestige goods.

Patrimonial rhetoric is the "manipulation of kinship ties to mobilize labor and resources," while prestige goods, like exotica, are "valuable, non-local items increasingly substituted in midlevel societies for food and utilitarian items exchanged in simpler systems," (Whalen and Minnis 2000:174).

Dual Processual Theory calls the kinship ties into play - a successful individual will be able to use patrimonial rhetoric in order to "divert prestational goods and followers away from potential competitors" while controlling the production of goods at the local (household) level (Blanton et al. 1996:4). Because power systems in the network strategy are usually based on the development of contacts by an individual, this leadership strategy would only last for a generation, requiring new trade networks to be developed and creating an unstable power structure.

Unlike the network strategy, corporate strategy deals with the needs of the community, and thus is locally centered. The power of a corporate strategy is "derived from a local group" and exhibited through public works such as grand architecture for use by the community (Mills 2000:10-11). A key component of the network system, prestige goods, is not found in the corporate strategy (Blanton et al. 1996:7). Prestige goods increase inequality as a source of power, a concept that does not fit in the corporate schema. In order to restrain an individual from "power seeking," the corporate system allotted power "across a number of groups" through a hierarchical system. In this way, power is allocated to a number of people, which inhibits a monopoly of power (Whalen and Minnis 2000:174).

This type of power structure provides various benefits for the community. Corporate systems provide for public works and architecture, ritual, and greater overall equality within the community. More importantly, it provides a stratified system of "roles and statuses" in

order to keep the power hungry from taking over and forming a network system. This type of checks and balances system has been referred to as "structurally integrative classifications" (Blanton et al. 1996:6).

Discussion of Dual Processual Theory

Theories about the socio-cultural development of polities such as Paquimé, and throughout much of Mesoamerica, have been centered on what has been deemed "a flawed neo-evolutionism" based on the theories of Spencer. Archaeologists have, in the past, attempted to define these cultures in terms of evolutionary "stages" most commonly referred to as bands, tribes, chiefdoms, and states. This neo-evolutionary theory fails to consider the differences between societies that it deems similar according to the stage of development. Also, archaeologists have *assumed* causal linkages between "centralized political control, social hierarchy, and prestige economies," without considering the "political variation" within the communities of the Southwest (Mills 2000:5).

Dual Processual Theory sidesteps the attempt to classify polities along the 'social scale,' of the band/tribe/chiefdom/state model, and instead turns attention to the ways in which people developed networks of power (Blanton et al. 1996:2). This theory allows for the development of a power system at an intermediate stage, described as having "developed beyond egalitarian, consensus-based decision making but which lack formal stratification, rigid decision-making hierarchies, and bureaucratic authority" (Whalen and Minnis 2000:176).

This theory has also served to show that political development does not follow a regimented course in which a band automatically transforms into a tribe and so on. There are

intermediate steps in which the community may be neither a 'band' nor a 'tribe.' There is disagreement within the field of archaeology on this point. Some feel that the Dual Processual Theory is simply adding another level to the stages of development. It is seen as an exercise in further subdividing and classifying systems. Unlike past theories which suggested a heterogeneous political structure based on the common appearance of the pueblos, the Dual Processual Theory calls for the critical evaluation of the archaeological record as a way to determine the political infrastructure in a particular place, at a specific time. Blanton et al. (1996:14) attempt to explain sources of power and inequality, instead of locating a polity on a point in the social scale of development.

Dual Processual Theory has been recently applied to derive patterns and follow the expansion of power and leadership development in the American Southwest and northern Mexico. This theory was developed to aid in discerning types of sociopolitical organization at sites in middle and southern Mesoamerica. Many other archaeologists have adopted and adapted the theory for the benefit of their own research. Work done by Whalen and Minnis (2001), Feinman (2000:223-4), and Graves and Spielmann (2000) has relied on the Dual Processual Theory to describe the activities of the people who lived in the pueblos of the Southwest and in northern Mesoamerica. They have all found it to be a useful tool in analyzing the sociopolitical structure of the region. The application of Dual Processual theory is effective because it takes into account the fluidity of culture. Whalen and Minnis, as well as Feinman, have used it in their study of Paquimé, and Graves and Spielmann have used it to construct leadership patterns and feasting traditions in the pueblos of the Rio Grande in the American Southwest.

Application of Dual Processual Theory to Paquimé

Paquimé may have operated under the corporate system in the early days before the population grew and new leadership roles were required. As previously discussed, the water irrigation systems exhibit localized, communally-created characteristics. Later, as the population expanded past a point of egalitarianism, local heterarchical rule was replaced by factionalized network power strategies.

What are the sources of power in societies such as Paquimé? How can an individual gain status in society? According to Blanton and colleagues (1996), in the course of exchange for the merchants of Paquimé, the aim was to develop *power*. The production and exchange of excess goods was a source of power, one that ultimately led to inequality (Mills 2000:7). It is limited access to goods, especially elite goods, which imbue power (Vargas 1999:8). Positions of power can be achieved by the accumulation of wealth through exchange, which builds upon itself as more exchange leads to more wealth. In the pursuit of greater wealth, people will attempt to produce excess for exchange (Layton 1997:7, Whalen and Minnis 2001:8).

In the network strategy of the Dual Processual model, elites must maintain control over the production and distribution of socially or ideologically valuable commodities, or prestige goods. A balance must be maintained in which access to the commodity is limited, but the supply is never completely cut off, as uncirculated prestige goods lose their value.

The questions posed by the Dual Processual Theory impact how archaeologists perceive the socio-political structure of the polities they study. This model informs on how and why particular goods came to be at a particular location. For example, elaborate grave goods in a stratified society, along with weaponry and articles deemed exotic may reflect a

network-type system of political development, whereas a lack of exotic goods, along with fairly heterogeneous burials and the presence of utilitarian and ritual artifacts may point to a corporate-style political system.

Factionalism is a characteristic of the network strategy of the Dual Processual Theory, as is the presence of exotica. As discussed earlier, evidence of factionalism exists at Paquimé. The location of ball courts, roasting pits, and macaw cages away from the center of Paquimé is a reflection of its decentralized government. In addition, macaw feathers, shell, and copper bells dispersed throughout Paquimé indicate that its inhabitants were involved in the movement of goods over long distances. It is likely that individuals within Paquimé began to participate in long-distance trade because of their proximity to established trade routes, a perspective consistent with the network model.

Exotica at Paquimé

Archaeologists have addressed the presence of exotica and prestige goods found in Paquimé. Individual attention has been given to the exotica, namely macaw feathers, shell, and copper bells. The quantities of these items found at Paquimé have been analyzed and their importance debated.

For this project, I researched these three types of exotic goods. The macaw feather and shell ornaments, while important, were difficult to trace back to their point of origin. The copper bells were useful for this research project because they can be traced to their source(s) through spectrographic and chemical analysis.

Macaws

Despite the large quantity of remains found there, macaws are the least discussed exotic object in the realm of Paquimé exchange. Macaws are known to have been captive bred and housed at Paquimé, and the number of remains supports the theory that Paquimé was the source of macaw feathers to a large trade area (McKusick 2001:102, Neitzel 1989:151).

Scarlet macaws are indigenous to the humid lowlands of Mexico, and many believe the parrots came to Paquimé from Oaxaca. The 503 specimens span a large range of ages, including nestlings 0-6 weeks old. These age ranges indicate that Paquimé was the primary, if not sole, source of macaws and macaw feather objects in north Mexico and the American Southwest. After successfully establishing a breeding colony at Paquimé, feathers and birds were traded north into the Southwest. The distribution of macaw cage door stones indicates that aviculture occurred within Paquimé and very little occurred past the 30 km buffer zone. Evidence for aviculture was equally common in both small and large sites, indicating that the macaw trade was a staple to the economy of Paquimé and not practiced solely by aspiring leaders (Whalen and Minnis 2000:176). Macaws, along with other exotic items, were traded into the Southwest. Comparisons between Hargrave's macaw distribution models and Bradley's shell distribution models have revealed that Paquimé traded both along a common network (Bradley 1993:127, Bradley 2000:176).

The Hohokam appear to have declined to actively participate in the trade of macaws and their feathers. Only one nearly complete specimen was discovered at the Gatlin site and several fragmentary specimens have been discovered in the archaeological record at Snaketown and a site in the northern periphery of Hohokam territory known as Az.T:4:8

ASM. None of these specimens date as early as the Hohokam classic phase, approximately 1100-1300 AD (McGuire 1993:101, Nelson 1986:171). As a comparison, more than 500 macaw remains have been identified at Paquimé. Hargrave records as many as 150 macaws throughout the Southwest, and Nelson reports approximately 3 macaw remains at Hohokam sites (Hargrave 1970:52, Nelson 1986:171). Because of this, Paquimé appears to have been the regional supplier of macaws and macaw feathers to the non-Hohokam southwest.

Shell

The shell economy of northern Mexico was based largely on the demand for shell ornamentation in the Southwest. The most prolific varieties of shell used in the Southwest are those found on the West coast of Mexico, along the shores of the Gulf of California. Shell was brought into Paquimé where it was modified for consumption before trade. According to John Douglas, shell may not have come into Casas Grandes via the traditional trade routes. His research indicates that expeditions to the coast were made specifically for shell (Douglas 2000:202). Because of other trade relationships (copper, ceramics, macaws, etc) with coastal West Mexican communities, it is believed that the Paquimé obtained their shell as far south as the Banderas Bay area of Jalisco and Nayarit (Bradley 2000:177). Charles Di Peso places the area of shell collection at Guayamas, Sonora and the deltas of the Yaqui and Mátape rivers. Other sources have been identified as Cholla Bay, Desemboque, and Sinaloa-Nayarit (Di Peso 1974:6:401,:7:163).

Some of the shell goods found were worked in the "Casas Grandes" style; these included disc beads, tinklers, and pendants, as well as whole, unworked shell (Bradley 2000:169). In Di Peso's original model of Casas Grandes, the shell was brought into

Paquimé to be worked by slaves in workshops. Archaeological evidence indicates that the shell was worked by individuals as a small-scale, cottage industry (Whalen and Minnis 2000:175.) Of the nearly four million pieces of seashell found, 96% were in warehouses at Paquimé. The remaining 4% was found in various "elite hoards," indicating that some of the residents of Paquimé had access to these goods, but the majority of the shell material was reserved for exchange (Bradley 1993:128, Whalen and Minnis 2000:171, Whalen and Minnis 2001:183).

Shell ornaments were imported into the Southwest long before Paquimé became a dominant exchange partner. Until the fluorescence of Paquimé, the Hohokam were known as the "shell suppliers of the Southwest," procuring shell goods from the east coast of the Gulf of California (Bradley 2000:167). In fact, not until the commencement of the Medio period did Paquimé become the primary source of shell and shell ornamentation in the Southwest. Together, the Hohokam and Sinagua maintained their own sources, while Paquimé provided other users in the American Southwest with their required shell products. Paquimé became a major source for shell approximately AD 1200, a time which witnessed the restructuring of political networks and alliances (Bradley 2000:179, Graves and Spielmann 2000:45). The Paquimé took advantage of this restructuring and apparently became the primary source of shell material in the Southwest.

In her research, Bradley was able to identify two distinct areas of shell use and exchange, based on style classifications. The earlier western exchange network can be dated as early as AD 900, though both networks are thought to have been in operation throughout the Classic period, approximately AD 1000 -1450. The assumption guiding this research is that sites containing similar artifacts were likely participants within the same interaction

sphere (Bradley 2000:169). The western group, identified primarily as the Hohokam, preferred bracelets, truncated beads, rings, and discs. These items were traded as early as AD 900, well before the rise of Paquimé. The southeastern group, identified as the Casas Grandes group, preferred the disc beads, tinklers and pendants. Material remains from both groups include whole unworked shells and fragments associated with shell ornament production. It is interesting to note that the Hohokam had multiple sites of production, while all of the shell ornaments traded within the Casas Grandes sphere was worked in Paquimé. Both maintained a stylistic identity, which allowed for easy classification of the two networks. This dichotomy also made it easy to identify the time frame in which Paquimé became the supplier of shell ornaments for the second group, because early artifact caches from areas in the Puebloan Southwest such as Swarts Ruin, Wind Mountain, and Cameron Creek reflected the Hohokam style, while later caches reflected the newer Casas Grandes style. Also, early Mogollon sites with pit structures contained Hohokam-style shell artifacts, whereas later artifact assemblages were identified as Casas Grandes style. The exception to this division in sources is the West Pueblo area, a zone in which both Hohokam and Casas Grandes style ornaments are found contemporaneously. However factionalized the western and southeastern spheres of exchange may have been, this particular area maintained a modicum of neutrality and traded within both networks (Bradley 2000:171). Therefore, Paquimé, when it emerged as a major exchange participant, was able to obtain a large 'customer base' previously served by Hohokam suppliers.

Copper Bells

Copper bells have an important place in Mesoamerican culture. They were believed to have been worn by deities and therefore were considered valuable objects by rulers and the elite, who wore them as well (Hosler 1988b:833). When Charles Di Peso developed his model of Paquimé, he explained the presence of more than 500 copper items there by citing Paquimé as a site for smelting and working copper artifacts. Through extensive spectrographic and chemical analysis, this notion has been called into question (Vargas 1995:6). Di Peso based his theory on the assumption that bells found in Paquimé were forged from ores found in nearby mines. In fact, there are copper mines near Casas Grandes. However, local ores tested did not contain silver and lead – as ores from West Mexico do. It is because the bells at Paquimé were tested and found to contain silver and lead that Vargas places the source for the copper bells in West Mexico (Vargas 1995:5).

'Evidence' of copper smelting has also been called into question, due to the small amount of ore found, in unknown proveniences (some was found in fill, other pieces found at unmapped surface locations). While there is evidence that there was cold hammering of a few pieces of raw (unsmelted) copper, there is none to prove copper was cast into bells at Paquimé. In fact, only agave ovens have been identified in the Paquimé region – further testing would be required to determine if copper was smelted there. It would appear that local people may have realized the proximity of a copper source would enhance their ability to produce copper objects without trading across West Mexico, though the copper readily available at Paquimé was not of the same quality as that in West Mexico, due to the inclusion of clay and other materials in the ore. Therefore, archaeological evidence indicates that most

of the 556 copper items found at Paquimé were mined, smelted, and worked by metallurgists in West Mexican workshops.

Metallurgy had been practiced in West Mexico since approximately AD 800. Prior to that, the people of West Mexico had imported their copper goods from two major regions, lower Central America and Columbia, as well as Ecuador, Peru, and Bolivia. From its earliest practice, the West Mexican worked-copper inventories most closely resembled those of Ecuador (Hosler 1988b:835). The caveat to this is the cast bells, which reflect the influences of Colombia, Panama, and Costa Rica. Casting was not a practice used by Ecuadorian metallurgists, so the source of this technology is from another location. All West Mexican bells are outfitted with a suspension ring and a clapper, stylistic markers also seen on bells manufactured by South American metallurgists (Hosler 1988b:839). During the second phase of copper production, beginning sometime during the AD 1200 – 1300s, copper began to be alloyed with such materials as silver, tin, gold, and arsenic, which coincided with an expansion of copper artifact types. Once again, West Mexican metallurgists borrowed technology from the Ecuadorian metallurgists (Hosler 1988b:843).

In 1962, David Pendergast saw the need to develop a typology for all the copper artifacts being recovered in Mesoamerica and the Southwest. His goal was to unify the classifications made by archaeologists in prior studies of copper artifact assemblages, in order to trace the movement of these goods from source to user. He created three categories: utilitarian objects, objects of personal adornment, and ceremonial objects. These classifications are further subdivided into types and subtypes. Pendergast then collected data from archaeologists and synthesized a classification which includes artifact type, components, date range, and area of distribution (Pendergast 1962). Hosler (1988a) has

taken the bell classification system one step further by identifying composition and manufacturing techniques. Modern metallurgists can identify the mineral composition of the copper bells, which have been correlated into two contiguous phases. Therefore, bells that are composed primarily of copper can be dated between approximately AD 800 through some time between the 13th and 14th centuries, when alloys were intentionally created. Examination of a copper bell's microstructure through a process called 'metallography' can reveal the method(s) of manufacture (Hosler 1988a).

It is from this extensive classification that Victoria Vargas (1995) draws her information and synthesizes a model of copper bell activity for Paquimé. Through my own research, I have found that a variety of bells, of several different types, were commonly found in the archaeological record of Paquimé, as well as across a large area of the Southwest. Items found at Southwestern sites include bell necklaces, caches of bells, and assemblages that may have been worn as necklaces, bracelets, or anklets (Kelley 1995:172). The earliest copper bell date comes from Sacaton-phase Hohokam sites, dating AD 900-1000, well before Paquimé appeared (Vargas 1995:19).

There are approximately 31 Southwest sites where Phase I bells have been identified. These are primarily in Arizona, but have also been found in New Mexico. Phase I bells have been located as far north as Goodman Point site in Colorado. The bells appear to cluster around the Flagstaff area, Hohokam region, and Mimbres Valley in Arizona (Vargas 1995:44). Not surprisingly, there are areas in the Southwest with copper bell assemblages that are not found in Paquimé. This area of non-conformal bell usage is identified as the Hohokam region. During Phase II, there are 28 Southwest sites with copper bell inventories. As with Phase I bells, these are primarily found in Arizona. While Phase II bells are found at

locations in the same general area of the Phase I bells, the actual sites have changed. This is indicative of the movement of people across the landscape of the Southwest. There are three north Mexican sites which have bell assemblages in Phase II. They are San Joaquin Chihuahua, Ojo de Agua Sonora, and San Jose Baviacora, Sonora. All three lie on the western side of the Sierra Madres.

Chapter 3: Hypothesis and research methodologies

Statement of hypotheses and expectations

Archaeologists have studied possible growth and development models of both leadership strategies and trade networks based on sociopolitical and economic ties, as well as the influence Paquimé had on the surrounding communities. This thesis recognizes that Paquimé stands alone as an influential polity in the Chihuahua desert region. The mere fact that it 'sprang up' in an isolated location can be cited as evidence for its location along an established trade route. I will therefore test the hypothesis:

> Paquimé developed because of its geographic proximity to one or more pre-Hispanic trade routes, which had been established before its fluorescence.

The occupants of Paquimé owned and traded exotica, that much is known. This study is designed to investigate the fluorescence of Paquimé due to its location on preexisting trade routes which merchants used to move goods through Paquimé from West Mexico to the American Southwest. Determining potential paths, and therefore possible trade routes, through cost-surface analysis is important because it will provide a foundation, through scientific investigation, for development of further hypotheses concerning the growth and development of Paquimé on a larger scale.

> Through my research, I expect to find that Paquimé was indeed located in proximity to trade routes established during Phase I, approximately AD 800 ~ AD 1250.

This proximity led to the development of Paquimé into a large, wealthy polity until its decline at the conclusion of Phase II, approximately AD 1520.

GIS and network analysis of possible trade routes

The presence of exotic goods in Paquimé is indicative of participation in a larger exchange system. Specifically, juvenile macaw remains, shell imported from the Gulf of Mexico, as well as copper from Central Mexico have all been found at Paquimé. Di Peso theorized that this site was a major trade center developed by Mesoamerican *pochteca*. This investigation is designed to elucidate the origins of Paquimé as it participated in pan-American trade. My goal was to perform a "network analysis" in which I would "attempt to recreate a hypothetical network of paths" based upon my hypothesis that Paquimé developed because of its geographic location along likely established trade routes (Kantner 2004). In order to test this hypothesis, I conducted a cost-surface analysis to determine the location(s) of the most cost-effective travel route or routes. The location of Paquimé in relation to these routes has been evaluated to determine the likelihood that Paquimé grew as a result of its proximity to these possible trade routes.

My research plan consisted of a literature review of Paquimé and the trade goods associated with it, and developing a table for organizing this information. I then utilized a Digital Elevation Model (DEM) in order to perform a cost-surface analysis which would identify the most cost-effective routes for travel in the study area. After applying the data which I had gathered in the first step to the DEM, I conducted an analysis of the results.

For the first step in the research plan, I did a literature review of Paquimé in order to understand the current theories of its development and identify components of the archaeological record which may inform on exchange networks. There were three trade items which I felt were pertinent to the development of Paquimé as a trade center: macaws

and their feathers, shell, and copper bells. Identifying the origin of a particular macaw or its feather was not a feasible course of action. The source(s) of the seashell was identified as the west coast of Mexico, though the shell could have originated at any point from the Gulf of Mexico as far south as South America. Therefore, neither of these items was viable for my study of the possible trade network which would have affected the development of Paquimé. However, the copper bell inventories of Mexico and the American Southwest were ideal for such a research project. Through spectrographic and chemical analysis, the source of the bells could be identified. Therefore, I could connect the source(s) of each bell type with the end user, and determine possible trade routes, based upon a cost-surface analysis. I compiled the data necessary to develop an associated table with site names and fields with values for location, phase (I or II), bell type(s), quantity of each bell type, coordinates (in decimal degrees), elevation, and a field indicating whether the site participated as a "source" or "user." Some locations overlapped, or their coordinates were given as the nearest modern city. For example, Wukoki and Wupatki are essentially at the same location, and Bloom Mound is just east of modern Roswell, NM (Table 1). To begin the data collection, I created the table using bell types and locations as described by Pendergast (1962) and Vargas (1995). I identified all the bells which were found in Paquimé and categorized them as Phase II. Then, using data from Vargas (1995), I included all bell types and their associated sites based on positive identification of provenience. Next, I looked up the coordinates for the sites that were listed in the table. Of the 78 sites in the original table, only 44 were actually used in this analysis. This is because I narrowed the search to the five bells which occur during Phase II, two of which (IA1a and IC1a) are also traded during Phase I.

Table 4.1: Table of bell sites

NAME	LOC	PHASE	TYPE	QTY	LAT	LONG	ELEV	ROLE
76 Ranch	AZ	2	IC2a	3				user
Amapa	Nayarit	1	IA1a-i		21.783	-105.267	124	source
Amapa	Nayarit	1	IA5a		21.783	-105.267	124	source
Amapa	Nayarit	1	IC1a		21.783	-105.267	124	source
Amapa	Nayarit	1	ID1a		21.783	-105.267	124	source
Amapa	Nayarit	1	ID4a		21.783	-105.267	124	source
Apatzingan	Michoacan	2	IA1a-i		19.083	-102.35	369	source
Apatzingan	Michoacan	2	IA4a		19.083	-102.35	369	source
Apatzingan	Michoacan	2	2a		19.083	-102.35	369	source
Apatzingan	Michoacan	2	6a		19.083	-102.35	369	source
Apatzingan	Michoacan	2	IA5a		19.083	-102.35	369	source
Apatzingan	Michoacan	2	5b		19.083	-102.35	369	source
Aztec	NM	1	IA1a-i	1	36.822	-107.992	1741	user
Bernard	Guerrero	2						source
Black Falls Ruin	AZ	2	IA1a-i		35.57	-11.275		user
Bloom Mound	NM	2	IC10a	1	33.394	-104.523	1090	user
Bloom Mound	NM	2	IC1a	3	33.394	-104.523	1090	user
Bonita	AZ	2	ID4a		32.59	-109.969		user
Cameron Creek	NM	1	IA1a-i	1	32.859	-108.145		user
Canyon de Flag	AZ	1	IA1a-i	2				user
Casa Grande	AZ	2	IA1a-i	7	32.978	-111.517	446	user
Casa Grande	AZ	2	IC1a	1	32.978	-111.517	446	user
Chavez Pass	AZ	2	IA1a-i	1	34.78	-111.14		user
Cherry Creek	AZ	2	IA4a	1	34.307	-111.342		user
Cherry Creek	AZ	2	IC10a	1	34.307	-111.342		user
Cherry Creek	AZ	2	IC13a	3	34.307	-111.342		user
Cherry Creek	AZ	2	IC1a	2	34.307	-111.342		user
Cherry Creek	AZ	2	ID9a	1	34.307	-111.342		user
Cherry Creek	AZ	2	IE2	1	34.307	-111.342		user
Cherry Creek	AZ	2	IE3a	1	34.307	-111.342		user
Cojumatlan	Michoacan	1	IA1a-i		20.117	-102.833	1548	source
Cojumatlan	Michoacan	1	IC1a		20.117	-102.833	1548	source
Copper Bell Ruin	AZ	1	IA1a-i	5				user
Cox Ranch	AZ	2	IA4a		34.344	-108.495		user

Culiacan	Sinaloa	2	IA1a-i		24	-107.033	2	source
Delgar Ruin	AZ	2	IA1a-i		34.956	-110.333		user
Delgar Ruin	AZ	2	ID1a		34.956	-110.333		user
Dona Anna Target Range	NM	2	IA1a-i					user
Dragoon	AZ	2	IA1a-i		32.028	-110.038		user
El Chanal	Colima							source
Flagstafff	AZ	1	IA1a-i	1	35.198	-111.65		user
Four Mile Ruin	AZ	2	IA4a	1	34.513	-110.078	1707	user
Four Mile Ruin	AZ	2	IA5a	1	34.513	-110.078	1707	user
Four Mile Ruin	AZ	2	IB2a	1	34.513	-110.078	1707	user
Galaz Ruin	NM	1	IA1a-i	1	32.856	-107.979		user
Galaz Ruin	NM	1	IC1a	1	32.856	-107.979		user
Galaz Ruin	NM	1	IC1c	1	32.856	-107.979		user
Gatlin Site	AZ	1	IA1a-i	8	32.948	-112.716	223	user
Gatlin Site	AZ	1	IB1a	1	32.948	-112.716	223	user
Gatlin Site	AZ	1	IC14a	2	32.948	-112.716	223	user
Gatlin Site	AZ	1	IC1a	40	32.948	-112.716	223	user
Gatlin Site	AZ	1	IC1b	1	32.948	-112.716	223	user
Gatlin Site	AZ	1	IC7a	4	32.948	-112.716	223	user
Gatlin Site	AZ	1	ID1a	4	32.948	-112.716	223	user
Gila Pueblo	AZ	2	IA1a-i	21	33.277	-112.166		user
Gila Pueblo	AZ	2	IC10a	7	33.277	-112.166		user
Gila Pueblo	AZ	2	IC12a	8	33.277	-112.166		user
Gila Pueblo	AZ	2	IC1a	1	33.277	-112.166		user
Gila Pueblo	AZ	2	IC8a	1	33.277	-112.166		user
Gila Pueblo	AZ	2	ID1a	1	33.277	-112.166		user
Gillespie Dam	AZ	1	IA1a-i	9	33.262	-112.981		user
Goodman Point	CO	1	IA1a-i	1	37.371	-108.77		user
Grasshopper	AZ	2	IA1a-i	3	34.076	-110.63	1828	user
Guasave	Sinaloa	2	IA1a-i		25.567	-108.45	19	source
Guasave	Sinaloa	2	5b		25.567	-108.45	19	source
Hervideros	Durango				25.15	-105.483	1716	source
Hilltop House	AZ	2	IC11a	1				user
Infiernillo	Guerrero	1	IA1a-i		18.15	-102.15	175	source
Infiernillo	Guerrero	2	IA1a-i		18.15	-102.15	175	source
Jiquilpan	Michoacan				19.983	-102.717	1597	source

Kinishba	AZ	2	IA1a-i	1	33.814	-110.053		user
La Ciudad	AZ	2	IA1a-i	2	33.448	-112.073	343	user
La Quemada	Zacatecas				23.3	-103.3	2174	source
La Villita	Michoacan	2			18.033	-102.183	20	source
Livingston Ruin	AZ	2	IB2a	2	33.501	-114.061		user
Los Hornos	AZ	2	IA1a-i		33.415	-111.909	364	user
Los Hornos	AZ	2	IC2a	1	33.415	-111.909	364	user
Los Hornos	AZ	2	ID4a	1	33.415	-111.909	364	user
Los Morteros	AZ	1	IA1a-i	1				user
Los Morteros	AZ	1	IC14a	1				user
Mammoth	AZ	2	IC6a	1	32.722	-110.64		user
Marana	AZ		IA1a-i	13	32.458	-111.208		user
Maricopa Road Site	AZ	1	IC14a	1				user
Mattocks Ruin	NM	1	IA1a-i	1	32.856	-107.979		user
Nan Ranch	AZ	1	IA1a-i	1	35.095	-106.67		user
Navocoyan	Durango		ID1a					source
Ojo de Agua	Sonora	2	IA1a-i	1	30.733	-110.683	1127	user
Old Town	NM	1	IA1a-i	1	35.095	-106.67		user
Osborn Ruin	NM	1	IA1a-i	1				user
Osborn Ruin	NM	1	IC14a	1				user
Paquime	Chihuahua	2	IA1a-i	50	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IA4a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IA5a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IA6a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC13a	52	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC18a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC19a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC1a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC20a	1	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IC2a	7	30.367	-107.917	1477	user
Paquime	Chihuahua	2	ID4a	7	30.367	-107.917	1477	user
Paquime	Chihuahua	2	IE2	1	30.367	-107.917	1477	user
Pinnacle Peak	AZ	1	IC7a	1	33.7	-111.901		user
Pollock Site	AZ	2	IA1a-i	2				user
Pottery Mound	NM	2	IC18a	1	34.806	-106.732		user
Pueblo Alto	NM	1	IC1a	1	36.069	-107.956		user
Pueblo del Arroyo	NM	2	IA1a-i		36.069	-107.956		user

Pueblo Grande	AZ	2	IA1a-i	1	33.445	-111.983		user
Robinson Site	NM	2	IC10a	1				user
Romo Site	AZ	1	IB1a	15				user
Rooney Ranch	AZ	1	IC14a	1				user
Roosevelt 5:10	AZ	2	IA4a		33.819	-111.27		user
San Joaquin	Chihuahua	2	IA1a-i	12	26.75	-107.667	966	user
San Jose Baviacora	Sonora	2	IA1a-i	1	29.75	-110.167	621	user
Sayula-Zacoalco	Jalisco				19.867	-103.6	1373	source
Schoolhouse Mesa	AZ	1	IA1a-i	1	33.819	-111.27		user
Schroeder Site	Durango							source
Snaketown	AZ	1	IC14a	28	33.183	-111.918		user
Snaketown	AZ	1	ID1a	28	33.183	-111.918		user
Tepalcatepec	Michoacan				19.183	-102.85	380	source
Tepic	Nayarit	2	ID4a		21.517	-104.883	912	source
Texmilincan	Guerrero							source
Tomatlan	Jalisco	1	IA1a-i		19.933	-105.25	124	source
Tse Tlani	AZ	1	IC1a	1				user
Tuxcacuesco	Jalisco	2	1b		19.683	-103.967	796	source
Tuxcacuesco	Jalisco	2	7c		19.683	-103.967	796	source
Tuxcacuesco	Jalisco	2	5b		19.683	-103.967	796	source
Tzintzuntzan	Michoacan	2	4a		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	7a		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	7b		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	8a		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	10b		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	9a		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	ID1a		19.617	-101.583	2205	source
Tzintzuntzan	Michoacan	2	ID4a		19.617	-101.583	2205	source
Wukoki	AZ	2	IA5a		35.521	-111.371		user
Wupatki Pueblo	AZ	1	IA1a-i	3	35.521	-111.371		user
Zape	Durango	2	IA1a-i		25.767	-105.783	1991	source
Zape	Durango	2	IC1a		25.767	-105.783	1991	source
Zapotitlan	Jalisco				19.55	-103.808	1151	source

For this research, I selected five bell types for the purpose of mapping. They are the IA1a, IA4a, IA5a, IC1a, and ID4a bell types (Fig. 3.1). The IA1a and IC1a bell types are found in both phases; the IA4a, IA5a, and ID4a bell types are found only during Phase II. Through my analysis, I have discovered that the user sites have shifted from the previous phase. In fact, none of the Phase II bells are found at the same sites that used Phase I type bells. The sites used in this analysis are listed in Table 2 and Table 3. The sources of Phase I bells are Amapa Nayarit, Cojumatlán Michoacan, Infiernillo Guerrero, and Tomatlán Jalisco. The IA1a bell type comes from all four sources; the IC1a bell type is only sourced from Amapa and Cojumatlán. Infiernillo is the only source site for both phases. During Phase II, bells are sourced from Apatzingan Michoacan, Culiacan Colima, Guasave Sinaloa, Infiernillo Guerrero, Tepic Nayarit, Tzintzuntzan Michoacan, and Zapé Durango. Bell type IA1a is sourced from Apatzingan, Culiacan, Guasave, Infiernillo, and Zapé; both the IA4a and IA5a are sourced from Apatzingan, IC1a is from Zapé, and the ID4a bells are sourced from Tepic and Tzintzuntzan. Bell descriptions are after Vargas (1995).

The most common bell type is the basic IA1a series, a globular bell with a plain resonator and ring for suspension. This bell type, along with several others that originated in West Mexico, appears to have been introduced into the Southwest during Phase I (AD 800 – 1250). There are more than 60 of these bells throughout the Southwest in Phase I context, and approximately 50 at Paquimé in a Phase II context. In Phase I, the IA1a bell type is found at no less than ten Southwest sites: Aztec NM, Cameron Creek NM, Flagstaff AZ, Galaz Ruin NM, Gillespie Dam AZ, Goodman Point CO, Nan Ranch AZ, Old Town NM, Schoolhouse Mesa AZ, and Wupatki Pueblo AZ.

Figure 3.1: Bell Illustrations

IA1a

IA4a

IA5a

IC1a

ID4a

Table 3: Phase II Sources and Destinations

Bell Type	Source	Destination
IA1a	Apatzingan, Michoacan Culiacan, Colima Guasave, Sinaloa Infiernillo, Guerrero Zapé, Durango	Black Falls Ruin, AZ Casa Grande, AZ Chavez Pass, AZ Delgar Ruin, AZ Dragoon, AZ Gila Pueblo, AZ Grasshopper, AZ Kinishba, AZ La Ciudad, AZ Los Hornos, AZ Ojo de Agua, Sonora Paquimé, Chihuahua Pueblo del Arroyo, NM Pueblo Grande, AZ San Joaquin, Chihuahua San Jose Baviacora, Sonora
IA4a	Apatzingan, Michoacan	Cherry Creek, AZ Cox Ranch, AZ Four Mile Ruin, AZ Paquimé, Chihuahua
IA5a	Apatzingan, Michoacan	Four Mile Ruin, AZ Paquimé, Chihuahua Wukoki, AZ
IC1a	Zapé, Durango	Bloom Mound, NM Casa Grande, AZ Cherry Creek, AZ Gila Pueblo, AZ Paquimé, Chihuahua
ID4a	Tepic, Nayarit Tzintzuntzan, Michoacan	Bonita, AZ Los Hornos, NM Paquimé, Chihuahua

Table 3: Phase II Sources and Destinations

Bell Type	Source	Destination
IA1a	Apatzingan, Michoacan Culiacan, Colima Guasave, Sinaloa Infiernillo, Guerrero Zapé, Durango	Black Falls Ruin, AZ Casa Grande, AZ Chavez Pass, AZ Delgar Ruin, AZ Dragoon, AZ Gila Pueblo, AZ Grasshopper, AZ Kinishba, AZ La Ciudad, AZ Los Hornos, AZ Ojo de Agua, Sonora Paquimé, Chihuahua Pueblo del Arroyo, NM Pueblo Grande, AZ San Joaquin, Chihuahua San Jose Baviacora, Sonora
IA4a	Apatzingan, Michoacan	Cherry Creek, AZ Cox Ranch, AZ Four Mile Ruin, AZ Paquimé, Chihuahua
IA5a	Apatzingan, Michoacan	Four Mile Ruin, AZ Paquimé, Chihuahua Wukoki, AZ
IC1a	Zapé, Durango	Bloom Mound, NM Casa Grande, AZ Cherry Creek, AZ Gila Pueblo, AZ Paquimé, Chihuahua
ID4a	Tepic, Nayarit Tzintzuntzan, Michoacan	Bonita, AZ Los Hornos, NM Paquimé, Chihuahua

During Phase II, the IA1a is found at more than a dozen sites in northern Mexico and the Southwest: Casa Grande AZ, Chavez Pass AZ, Gila Pueblo AZ, Grasshopper AZ, Kinishba AZ, La Ciudad AZ, Los Hornos AZ, Ojo de Agua Sonora, Paquimé Chihuahua, Pueblo Grande AZ, San Joaquin Chihuahua, San Jose Baviacora Sonora, Black Falls Ruin AZ, Delgar Ruin AZ, Dragoon AZ, Pueblo del Arroyo NM.

The IA4a bell is also a globular, round-bodied resonator with a ring for suspension. Stylistically, this bell is different from the IA1a because the body is decorated with striations that appear to be wire wrapped around it. The IA4a originates only in Apatzingan during Phase II, and is found at Paquimé Chihuahua, Cherry Creek AZ, Four Mile Ruin AZ, and Cox Ranch AZ.

The IA5a bell also originates in Apatzingan during Phase II. It too has the globular resonator and suspension ring. Its particular style marker is the raised "Tlaloc face" on the resonator. This bell is found at Four Mile Ruin AZ, Paquimé Chihuahua, and Wukoki AZ.

The IC1a bell is smooth, with a pear-shaped resonator and the suspension ring. During Phase I, it originates in Amapa Nayarit and Cojumatlán Michoacan, and is found in Galaz Ruin NM, Gatlin Site AZ, and Pueblo Alto NM. During Phase II the IC1a bell is sourced from Zapé Durango into Bloom Mound NM, Casa Grande AZ, Cherry Creek AZ, Gila Pueblo AZ, and Paquimé Chihuahua.

Finally, the ID4a bell has an elongated tear-shaped resonator with a suspension ring. The body is characterized by the "wirework" extending from the suspension ring down ¾ of the body to the mouth of the bell. The ID4a is a Phase II bell, originating in Tepic Nayarit and Tzintzuntzan Michoacan and found in Bonita AZ, Los Hornos NM, and Paquimé Chihuahua.

Five of the six IC1a bells sites are the same as locations which also have the IA1a bell type; the only exception is Pueblo Alto. During Phase I, the IC1a bell type is sourced from Amapa and Cojumatlán into the Gatlin Site and Pueblo Alto; during Phase II, Zapé is the source for Paquimé, the Gatlin Site, Cherry Creek, and Casa Grande. The ID1a bell type is primarily a Phase I export from Amapa into Delgar Ruin, the Gatlin Site, and Snaketown. During Phase II, this bell is found in Tzintzuntzan, Michoacan and Gila Pueblo. The opposite is true of the ID4a bell type. It is a Phase II export from Tepic, in Nayarit, and Tzintzuntzan into Los Hornos, Bonita, and Paquimé. It is found in Phase I context in Amapa.

Using ESRI ArcMap GIS software, I utilized a Digital Elevation Model of the study area, including New Mexico and Arizona and the Mexican states of Chihuahua, Sonora, Sinaloa, and portions of Coahuila, Durango, Jalisco, Michoacan and the northwestern section of Guerrero. The DEM projection was set to the Continental North American Geographic Coordinate System (GCS) using an equidistant conic projection. The central meridian was set to -111 in order to place Paquimé in the center of the projection, thereby minimizing the distortion along that meridian. This particular projection was chosen because a cost-surface algorithm should be based on a projection that maintains area and distance for accurate measurement.

A DEM is a tessellation model. The raster tessellation is the most commonly used because it is highly compatible with multiple types of hardware, graphic systems, and coordinate systems (Lo and Yeung 2002:80). A raster image is made up of cells in a grid, and each cell contains a value, such as soil type or elevation. Due to the size of my DEM, and because of the distance I needed to be able to map, each cell was 868 m. Raster images are useful for determining spatial relationships between adjacent cells, and for representing

continuous phenomena over a large area (Lo and Yeung 2002:67, 80). A DEM is a digital terrain data set that has been acquired *indirectly*. Indirect data acquisition involves the use of mathematical functions in order to create a surface based on real-world characteristics. However, the 'Elevation' of a DEM is the height above a datum, not sea level. The profile of a 7.5 minute DEM that is georeferenced to the Universal Transverse Mercator (UTM) system is expressed in meters (Lo and Yeung 2002:309).

The DEM used for this research was obtained from a Global 30-Arc-Second Elevation Data Set (GTOPO30) produced by the U.S. Geological Survey (USGS). 30 arc seconds are roughly equivalent to 1 km. Several organizations from many countries contributed to the development of the GTOPO30 project, which resulted in a digital terrain data set comprised of eight elevation data sources. These compiled sources are Digital Terrain Elevation Data, Digital Chart of the World, USGS DEM, U.S. Army Map Service maps, International Map of the World, Peru map, New Zealand DEM, and the Antarctic Digital Database (Lo and Yeung 2002:318). This data set can be accessed from the Earth Resources Observation System (EROS) Data Center.

After setting up the DEM, I imported the bell table into ArcMap as a .dbf file, and then converted into a theme, or layer. This step projected the geo-referenced sites as a shape file, on which I could conduct the cost grid analysis. Once the DEM and bell table were projected, it was necessary to create the cost grid. This function, programmed in ArcInfo, assigns a value to each cell in the DEM for calculating how much it would cost in time to cross that cell. Waldo Tobler's hiking function was used for the cost-surface analysis, because this function has previously been tested by archaeologists studying the movement of goods in the Southwest. Prior research using cost-surface analysis has indicated that people

in the Southwest utilized cost-effective paths to travel between communities. These studies are supported by the small villages and religious shrines that have been found in association with the cost paths (Kantner 1997, Kantner 2004). After overlaying the DEM with the cost grid, I was able to compute the most cost-effective path from each of the copper bell source sites in West Mexico to the end users in North Mexico and the Southwest. The hiking function is relevant because pre-Hispanic North America had no beasts of burden north of Peru, and therefore would approximate the condition experienced by a trader/merchant on foot. The formula for the algorithm is as follows (Tobler 1993):

$$T = D/(6 \exp(-3.5*\text{abs}(S + 0.05)))$$

In which T is the time required to cross a DEM cell, D is the distance of the DEM cell, in this instance 868 km, and S is the slope of each cell measured in percent rise. This formula will give the velocity at which a person can traverse each cell in kilometers per hour.

After creating the grid, I used Spatial Analyst in ArcMap to select the source site to then generate equal time distances for travel, represented by concentric circles radiating away from the origination point, in this case, the source of the copper bells (Tobler 1993). Then I chose the destinations that correlated to the specific bell type I was mapping by using the 'select by attribute' utility in ArcMap. The attributes I used were phase and bell type. Because I did not use Boolean identifiers for the 'source' and 'user' fields, I found it necessary to de-select the highlighted sources before performing the cost-surface calculations. ArcMap then calculated the most cost-effective path(s) for that specific bell type, based upon source site. Using this method, I generated a map showing routes for each source site. I generated two separate maps for Infiernillo, which was a source during both Phase I and Phase II.

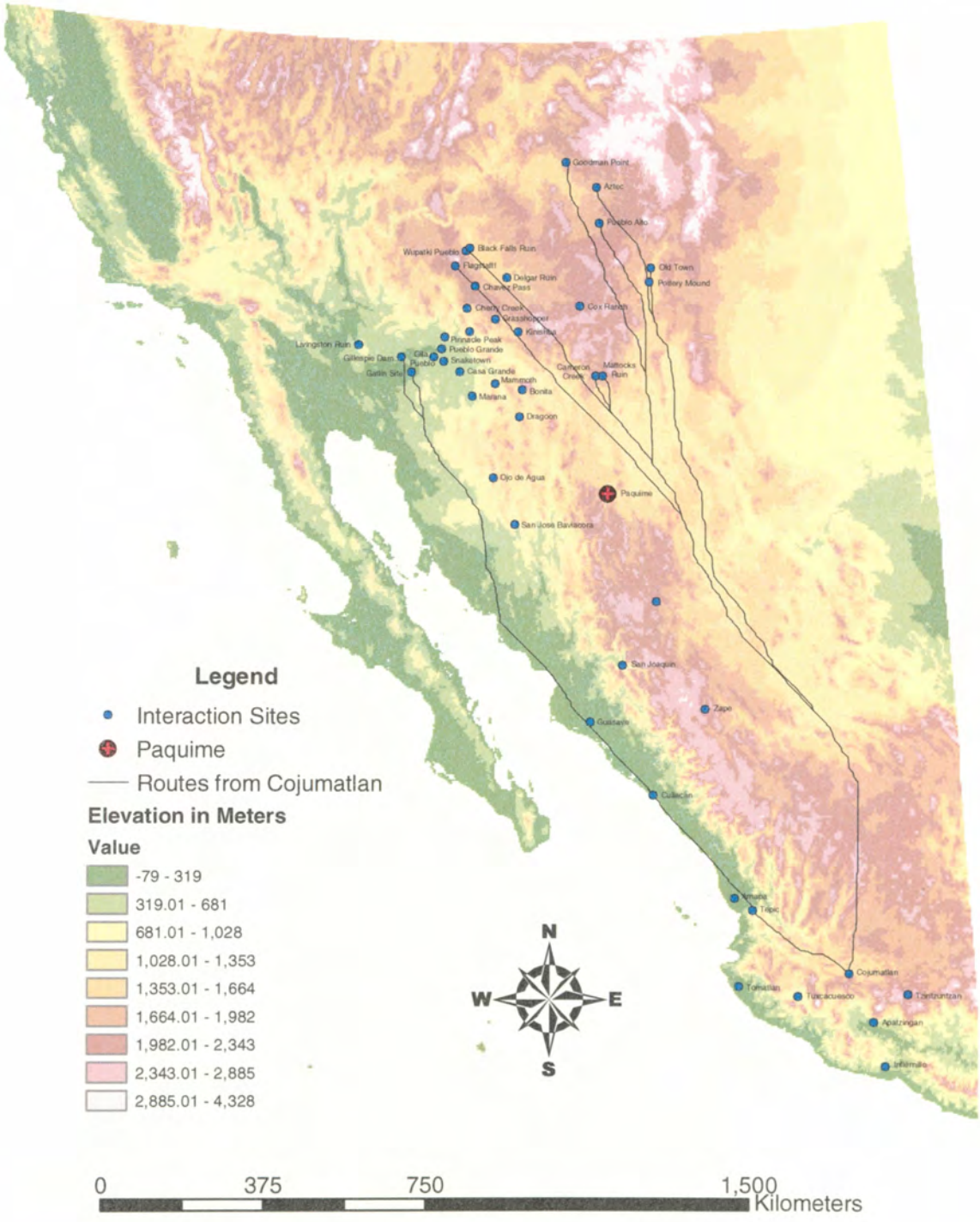


Figure 4.2: Possible Phase I routes from Cojumatlan, Michoacan

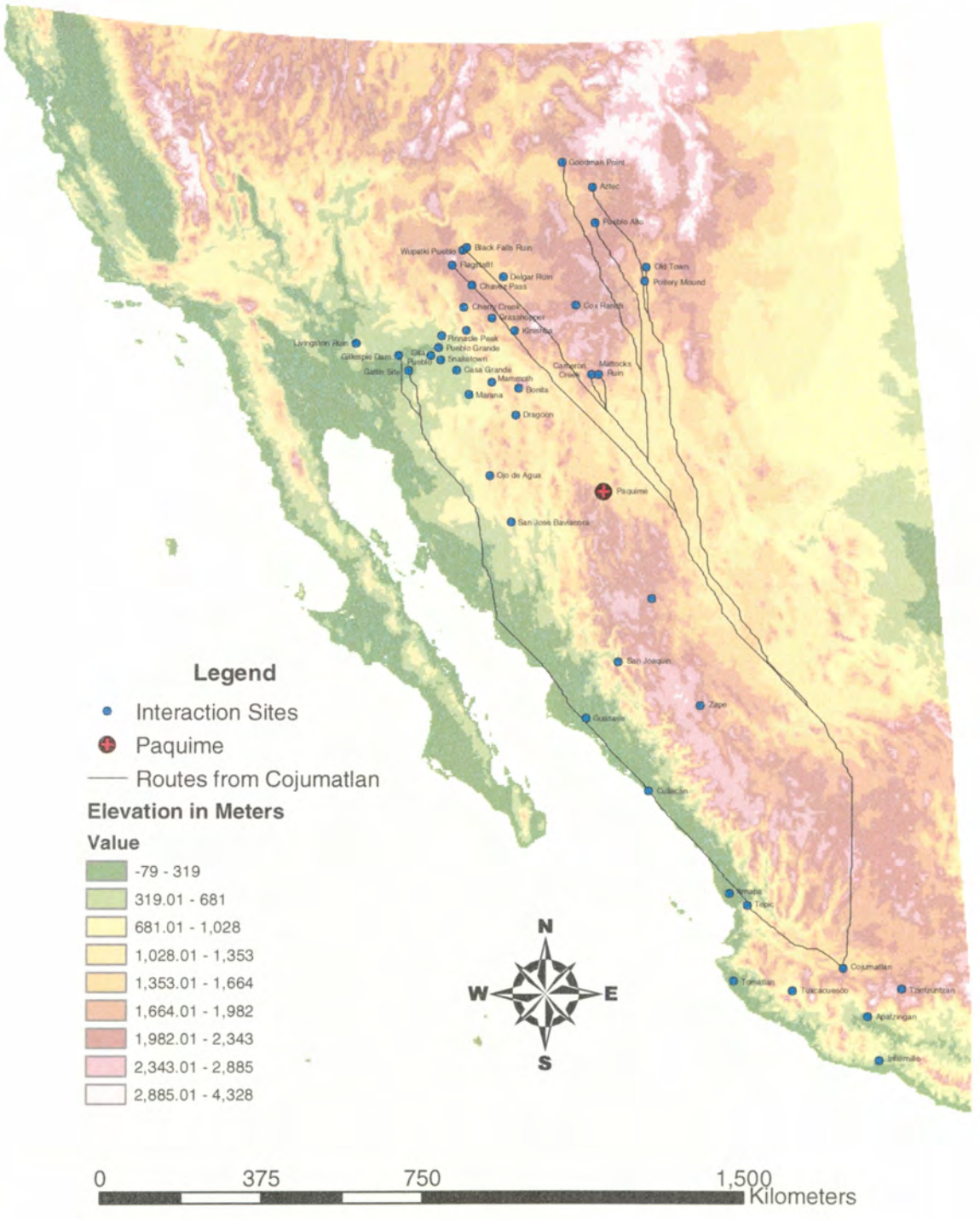


Figure 4.2: Possible Phase I routes from Cojumatlan, Michoacan

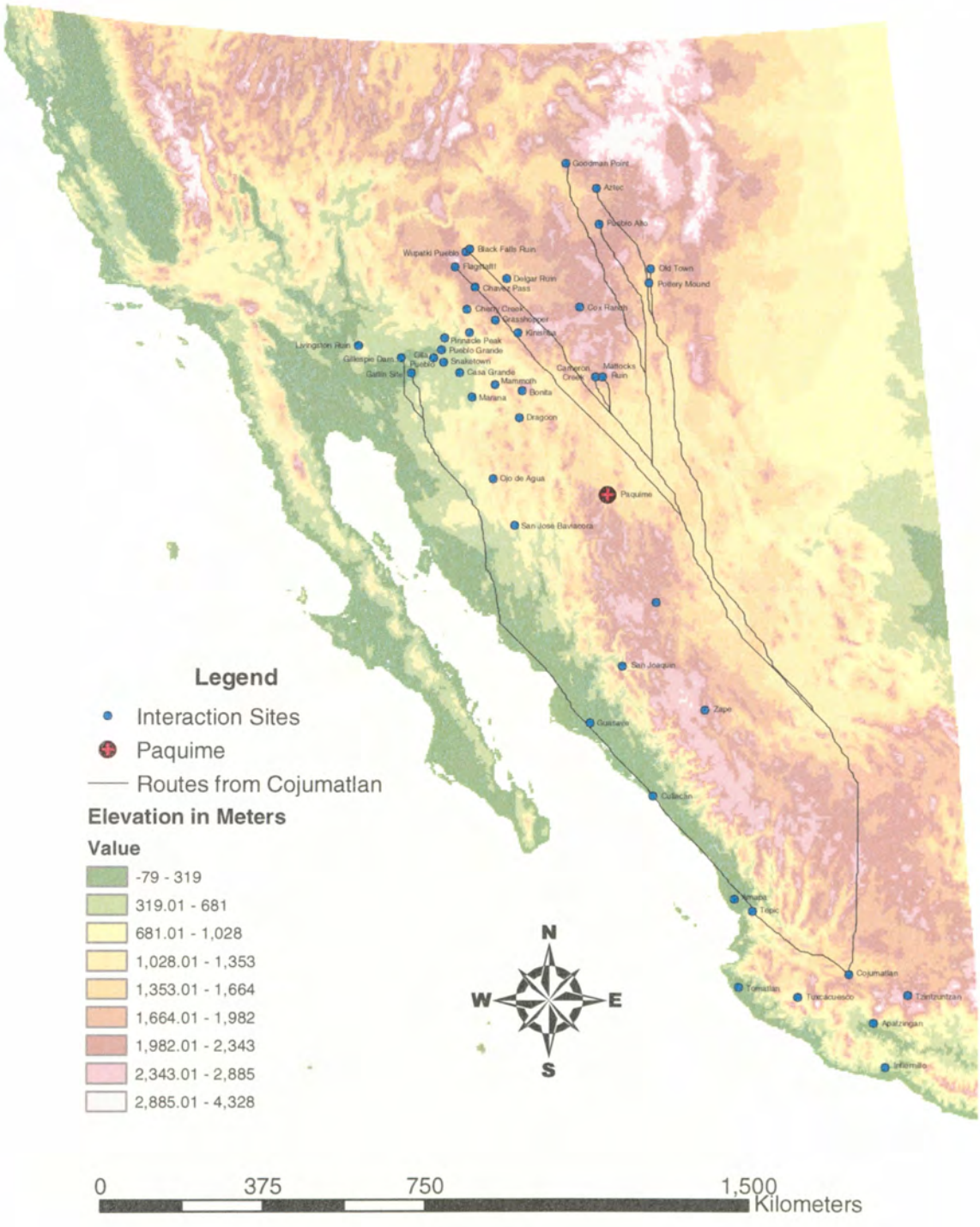


Figure 4.2: Possible Phase I routes from Cojumatlan, Michoacan

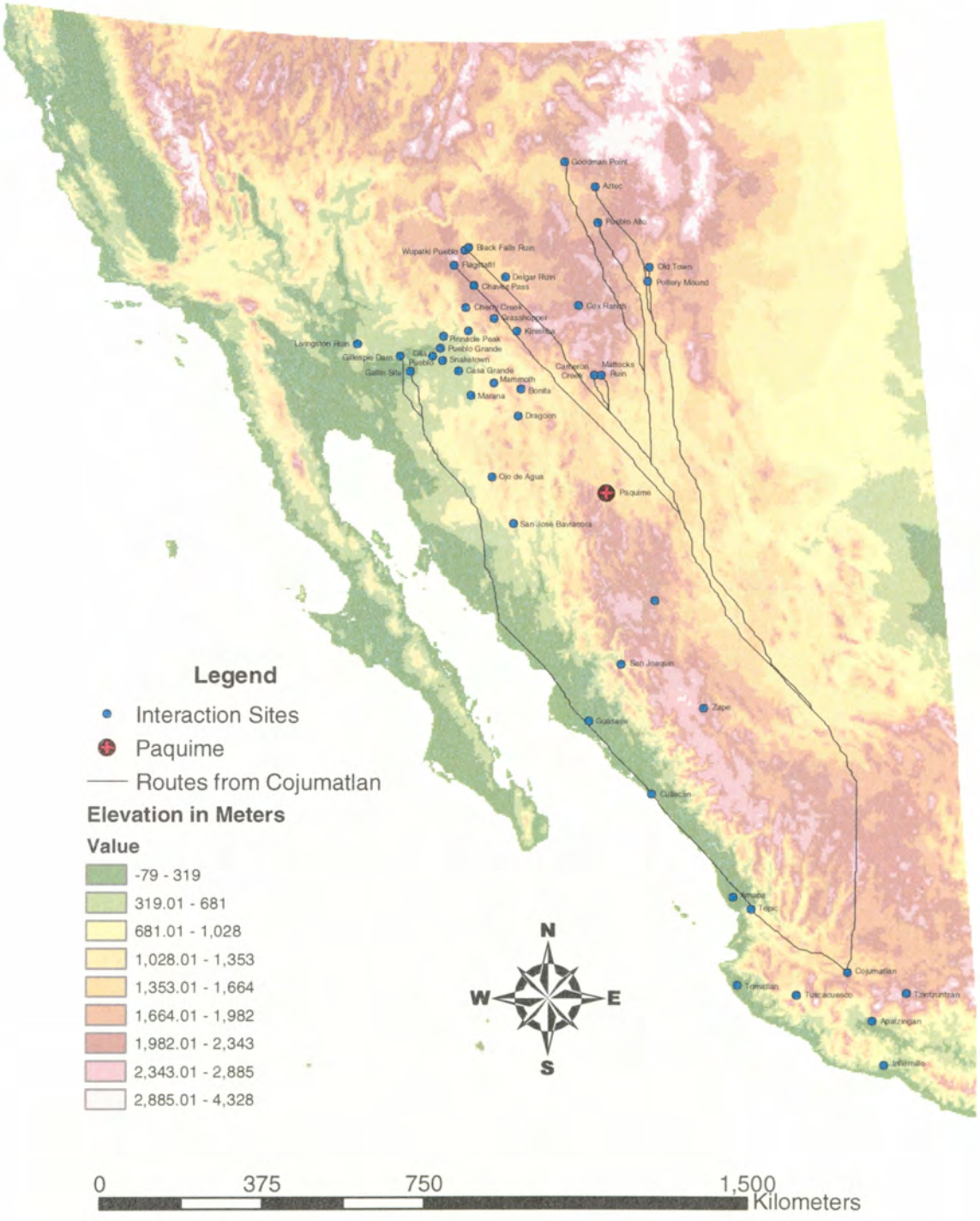


Figure 4.2: Possible Phase I routes from Cojumatlan, Michoacan

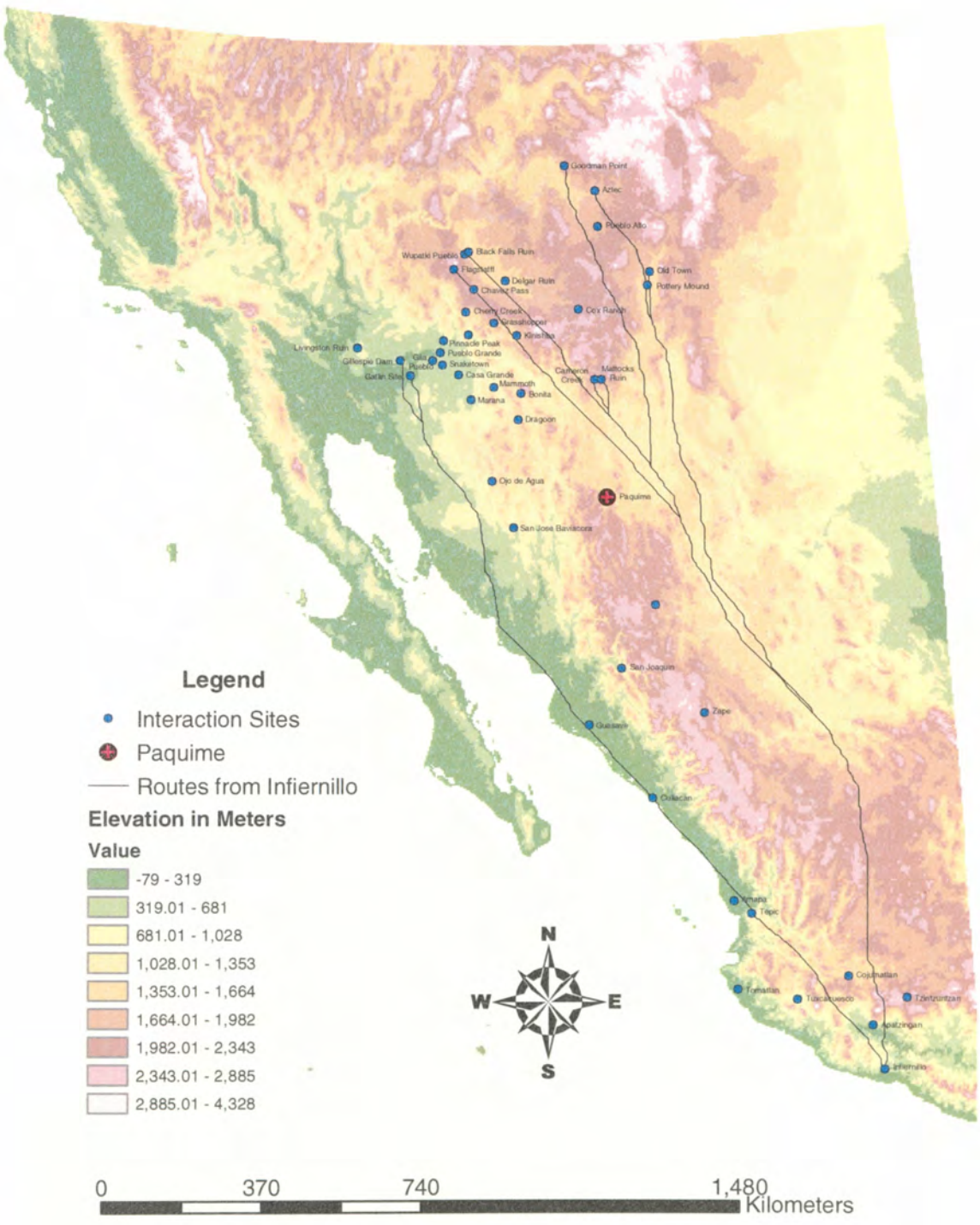


Figure 4.3: Possible Phase I routes from Infiernillo, Guerrero

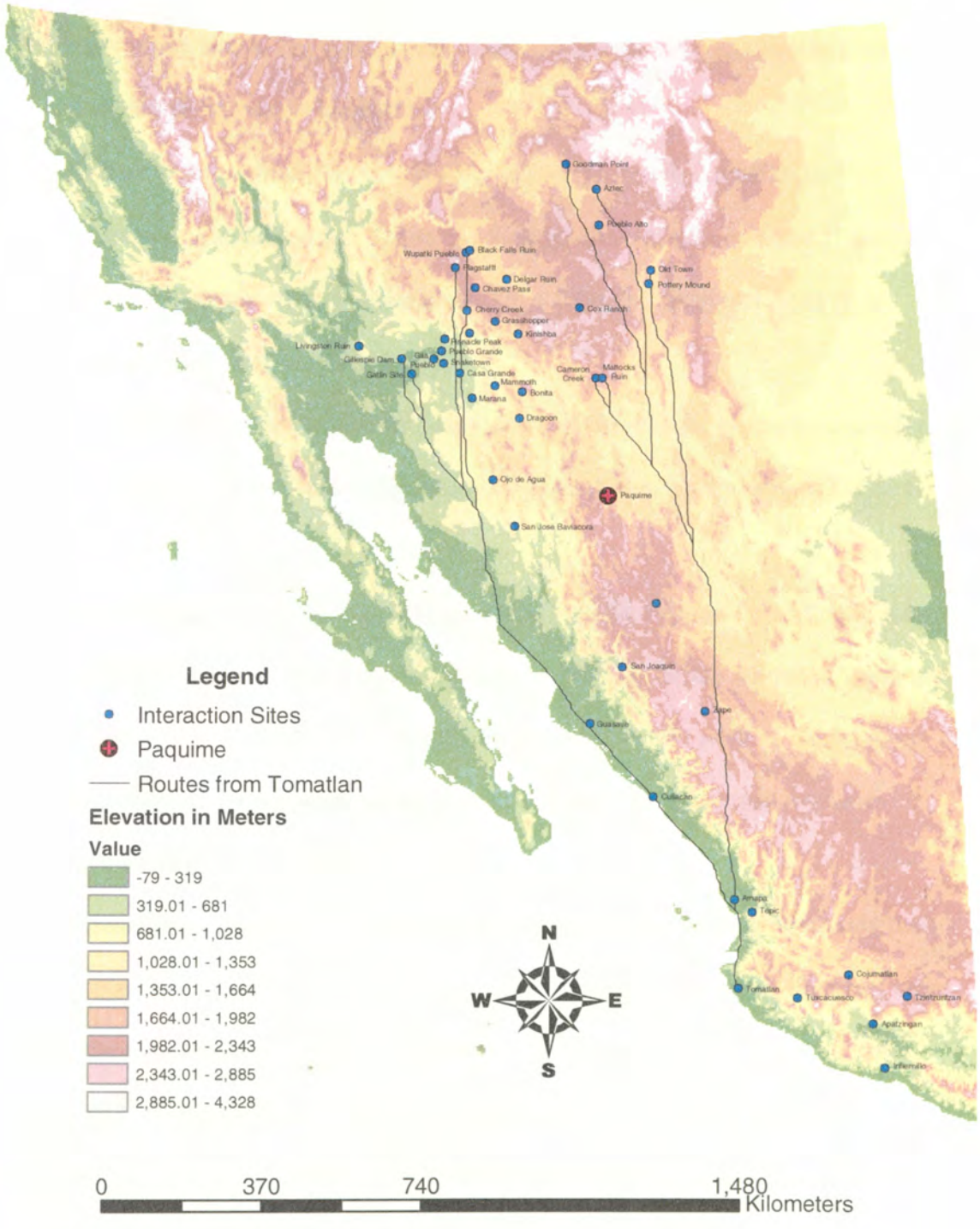


Figure 4.4: Possible Phase I routes from Tomatlan, Jalisco

The location and directionality of each of the routes varies according to where they end. For various sites, multiple routes were calculated. In some instances, there are multiple route segments which lead to one site; in other instances, a route will pass near or through another end site on its way to its destination.

The Phase II routes from Apatzingan (Fig. 4.5) most closely resemble the Phase I routes of Cojumatlán and Infiernillo. The routes for the IA1a bell type in Phase II from Apatzingan follow both coastal and inland routes. The IA4a and IA5a bell types from Apatzingan are mapped solely as inland routes.

The routes from Culiacan (Fig. 4.6) and Guasave (Fig. 4.7) are primarily coastal, with the exception of the routes that lead to San Joaquin and Paquimé, which traverse the Sierra Madres.

The routes from Infiernillo (Fig. 4.8) in Phase II are the same as Phase I, with the exception of those that lead to San Joaquin and Zapé. The route to San Joaquin follows the coast to just north of Culiacan, where it ascends the mountains. The route to Zapé from Infiernillo goes through Apatzingan, passes west of Cojumatlán, and crosses over the southern portion of the Sierra Madres.

The routes from Zapé (Fig. 4.9) either cross the Sierra Madres or follow along the piedmont as they bear north and west to the user sites. Because of the many IA1a bell users in Phase II, the routes look almost dendritic as they branch out across the Sonora desert.

The route to Bonita from Tepic (Fig. 4.10) follows the coast up to the area of Guaymas; the route to Paquimé crosses the Sierra Madres, and then passes west of Zapé as it heads north. The routes from Tzintzuntzan (Fig. 4.11) are similar to the inland routes of Cojumatlan and Infiernillo.

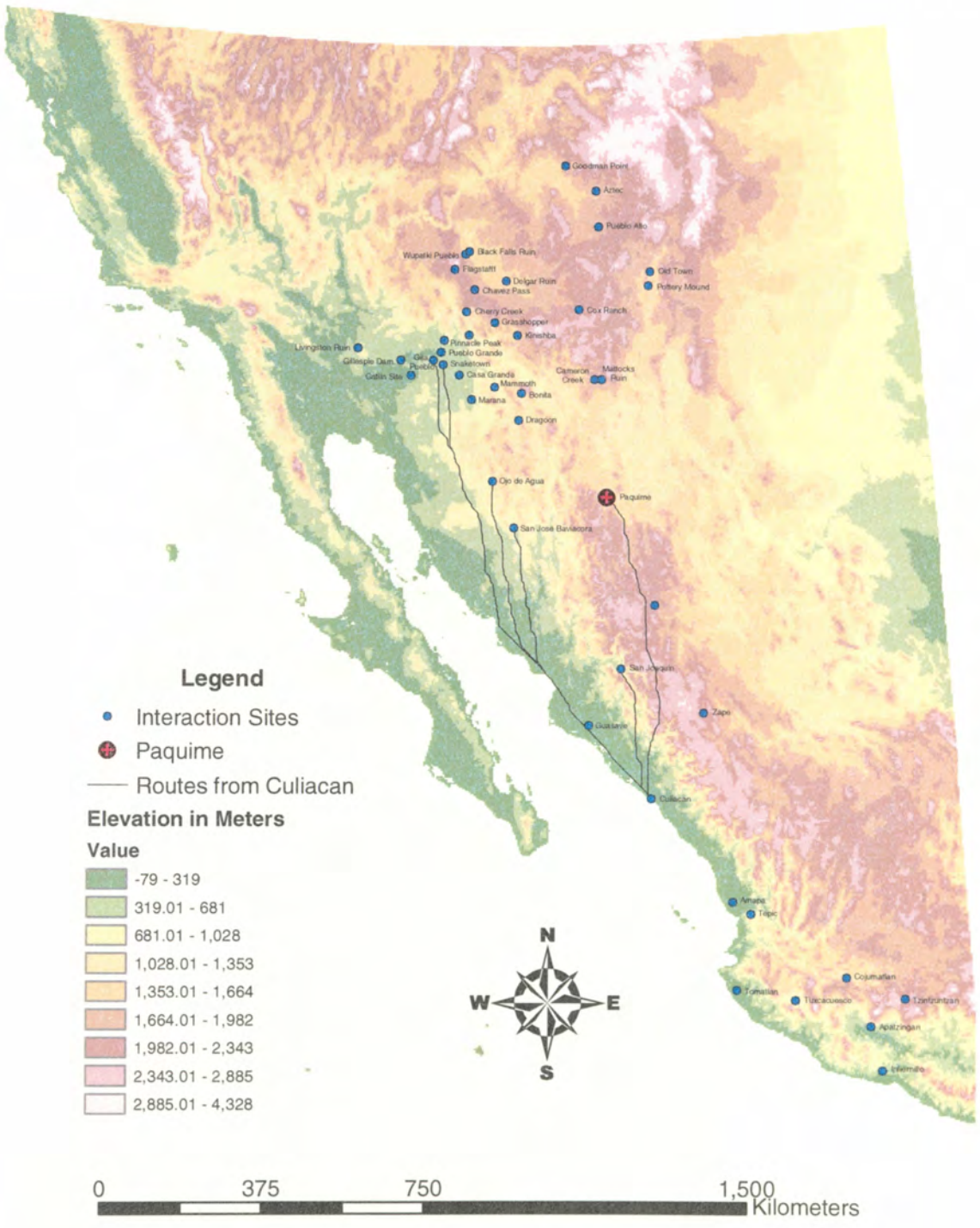


Figure 4.6: Possible Phase II routes from Culiacan, Colima

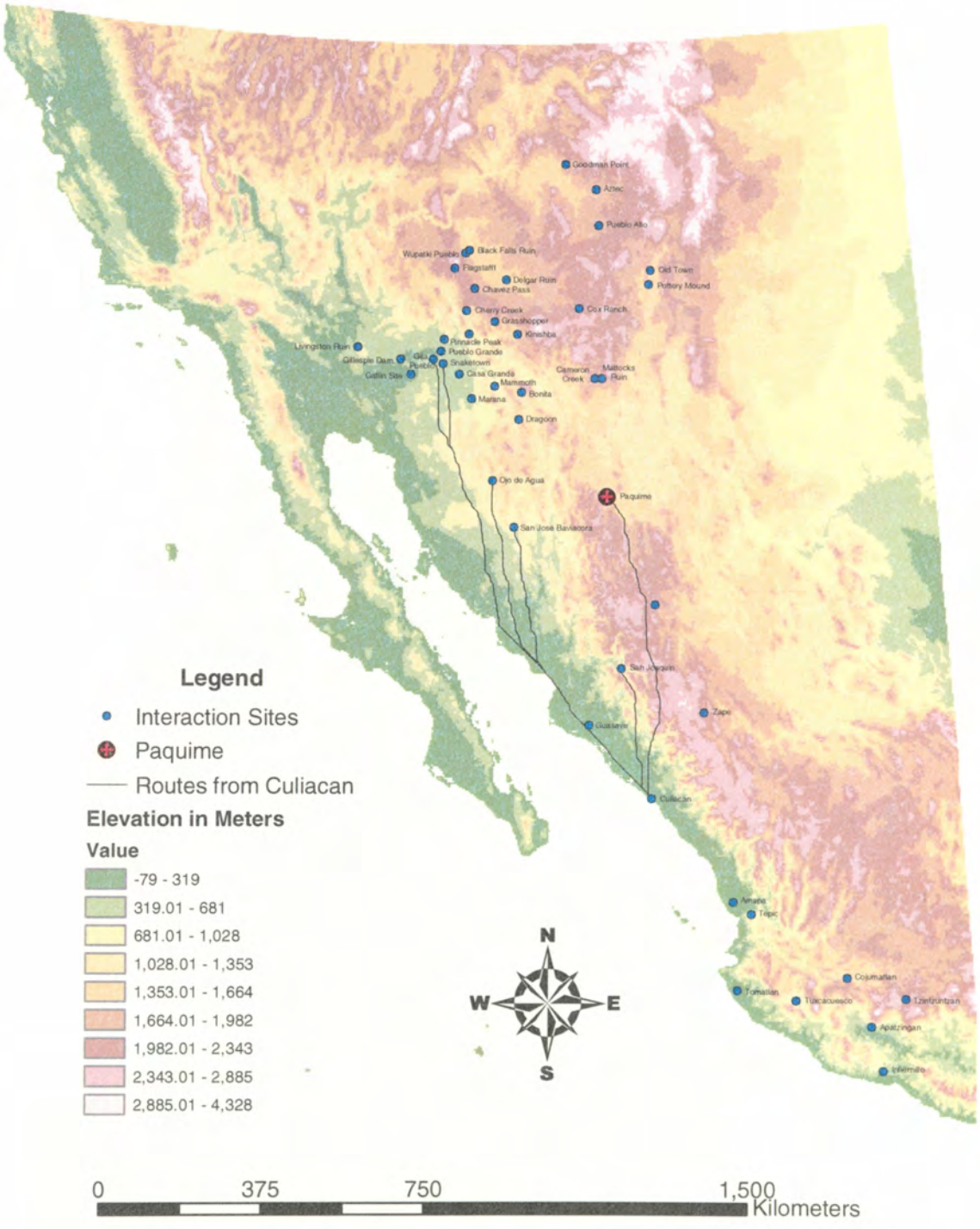


Figure 4.6: Possible Phase II routes from Culiacan, Colima

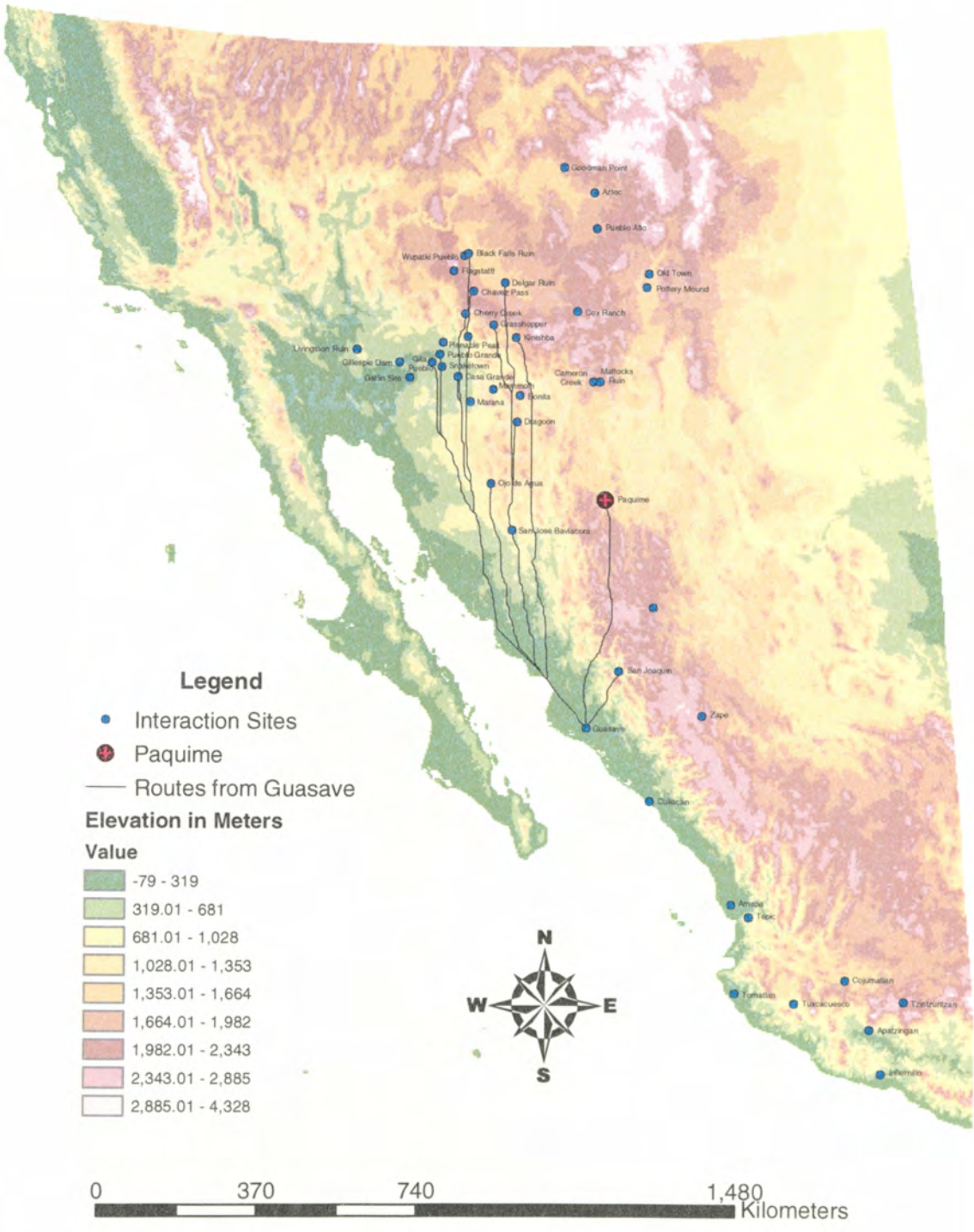


Figure 4.7: Possible Phase II routes from Guasave, Sinaloa

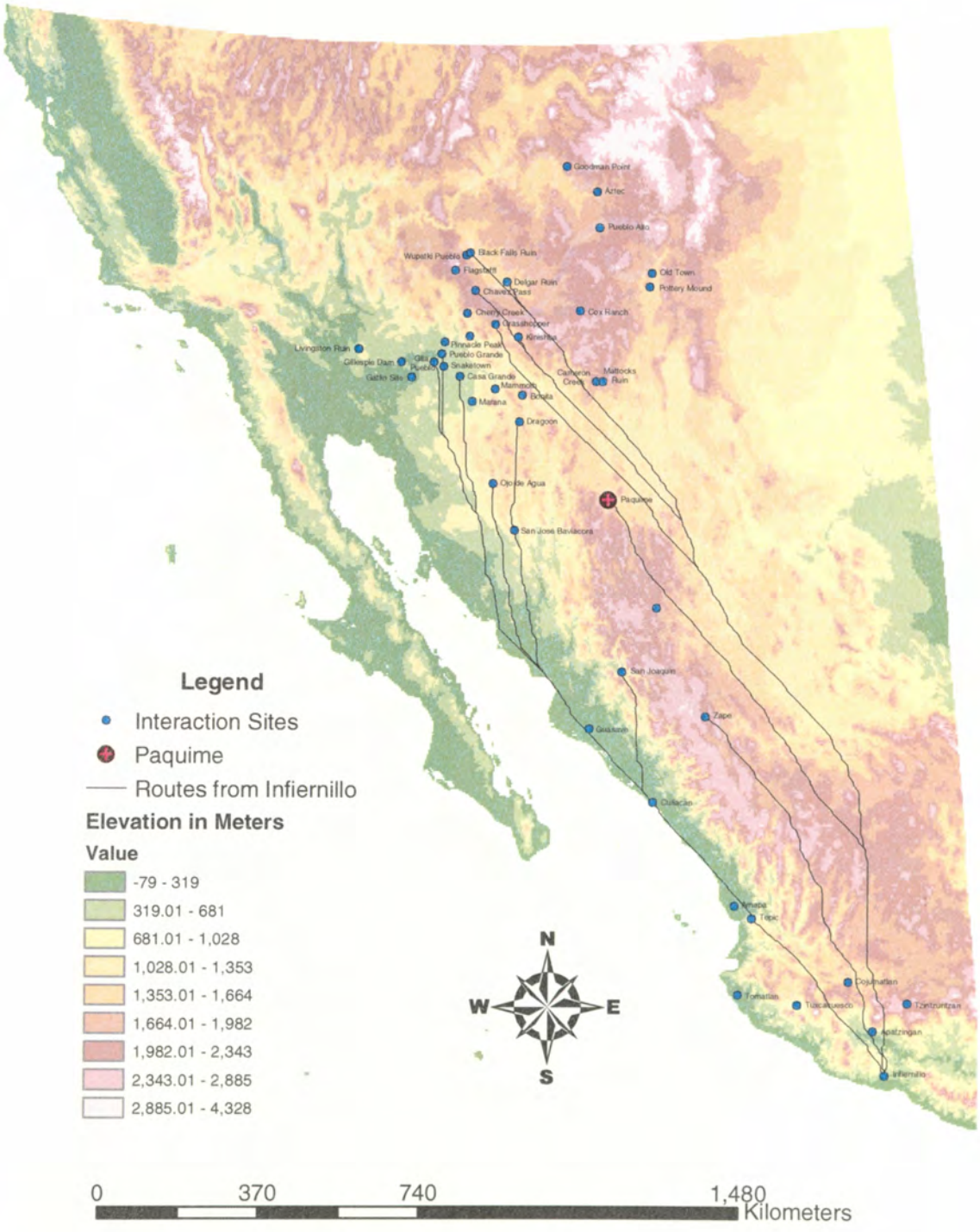


Figure 4.8: Possible Phase II routes from Infiernillo, Guerrero

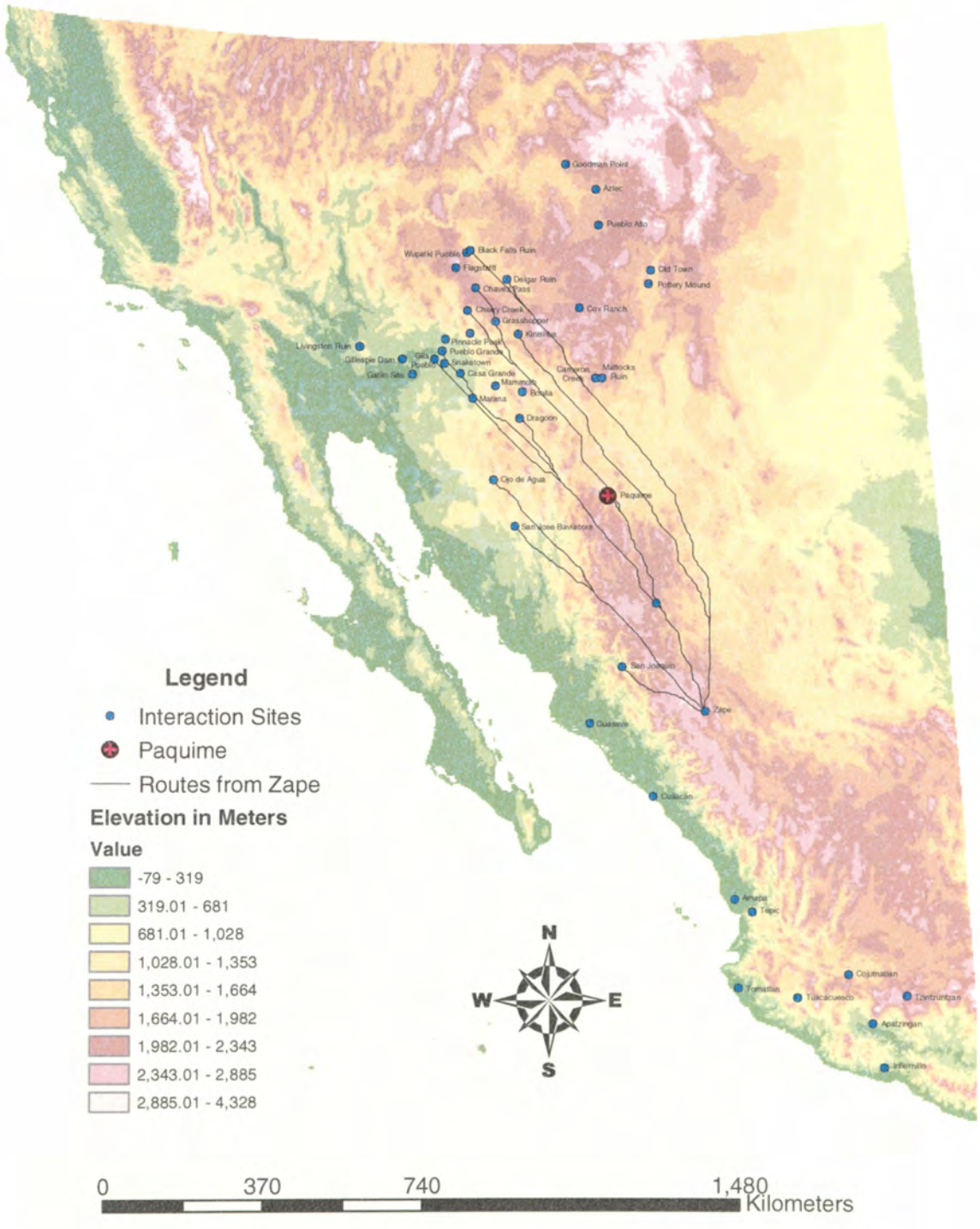


Figure 4.9: Possible Phase II routes from Zape, Durango

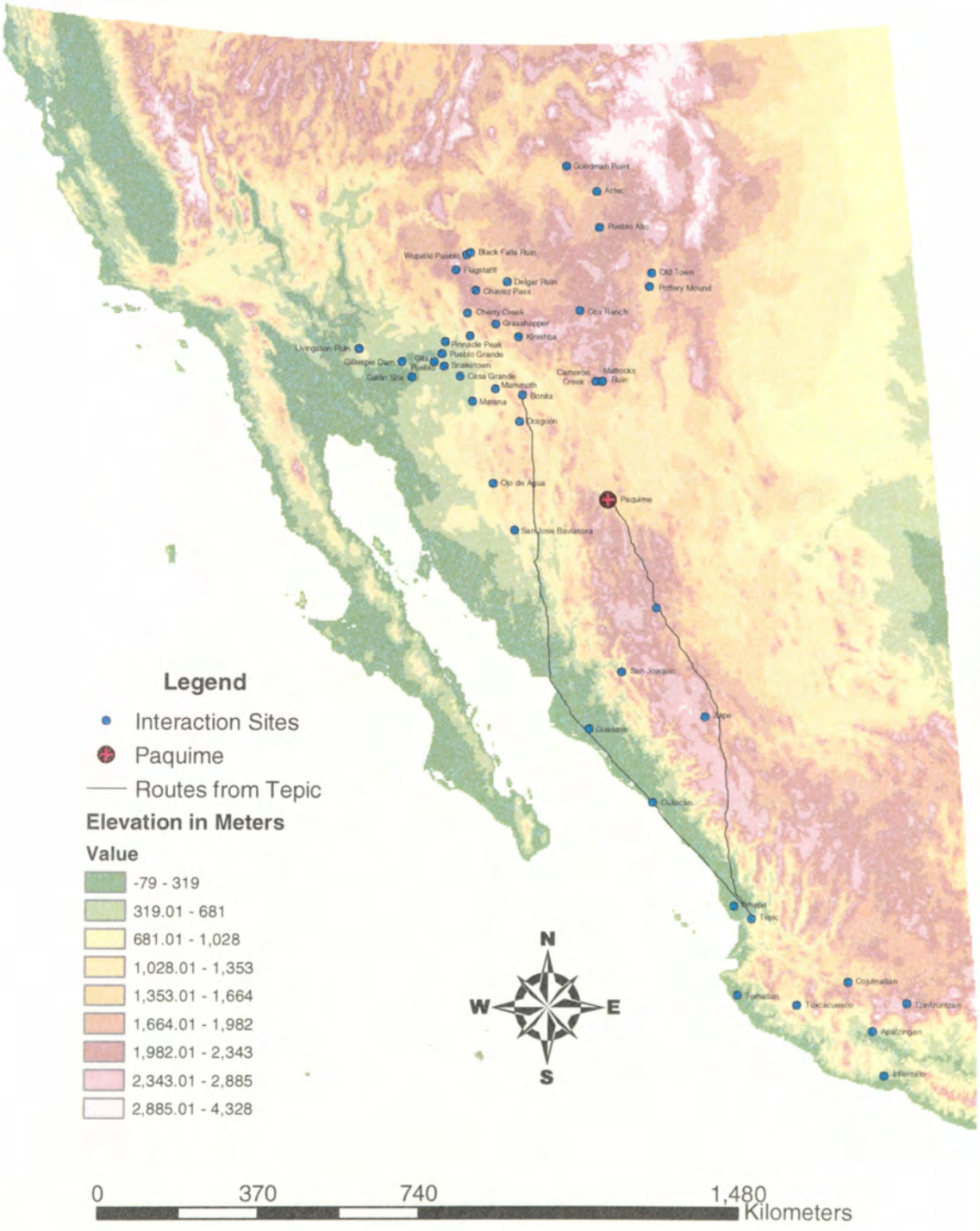


Figure 4.10: Possible Phase II routes from Tepic, Nayarit

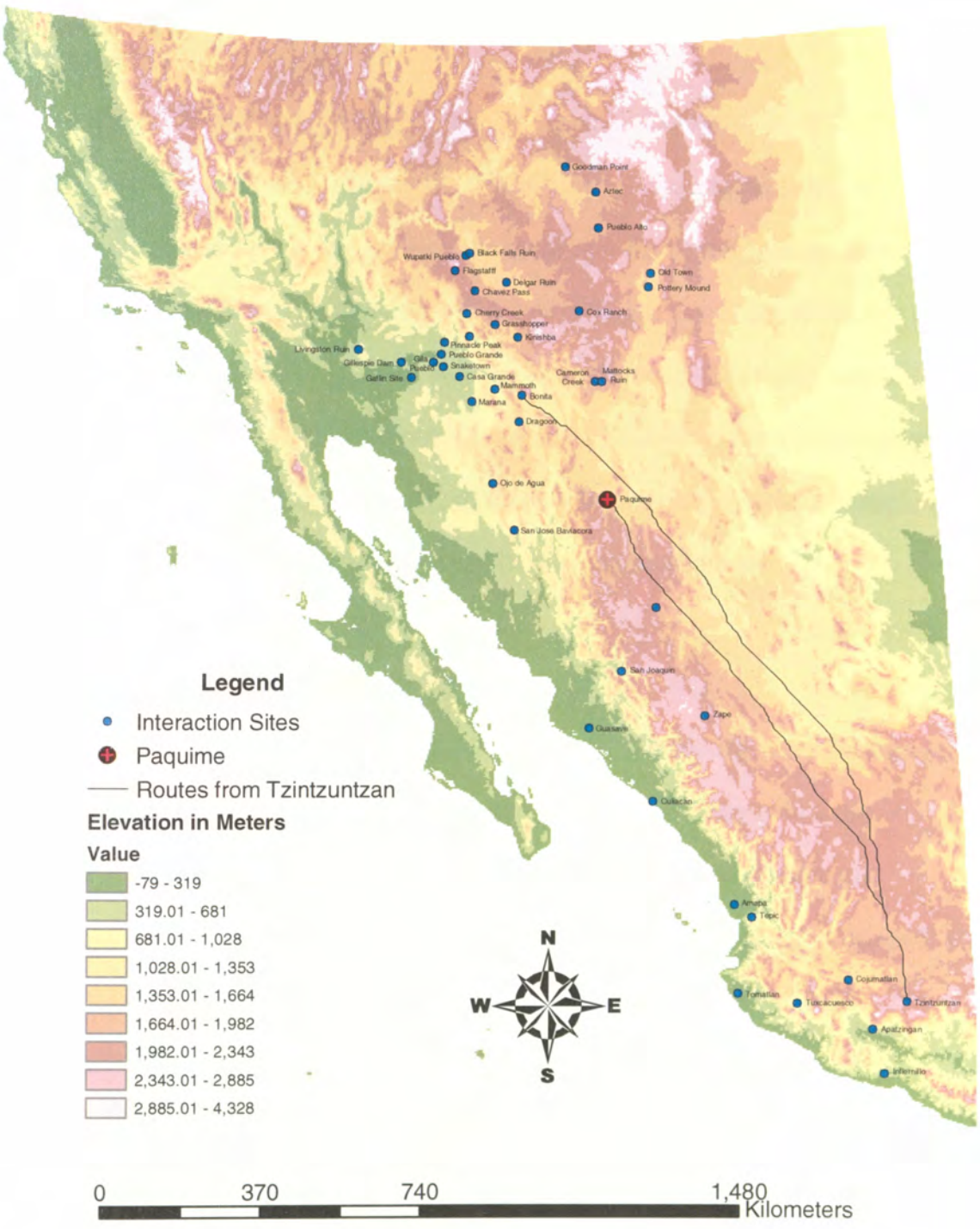


Figure 4.11: Possible Phase II routes from Tzintzuntzan, Michoacan

The site of Bonita, AZ is north-northwest of Paquimé, yet the routes from Tzintzuntzan to each of these places diverge at the southern tip of the Sierra Madres mountain range.

The route(s) for the bell type IA5a (Phase II) correspond to the routes of the IA1a (Phase II) routes from Infiernillo, which is almost due south of Apatzingan, Michoacan. Amapa, a coastal source, is located south of Zapé, but lies on the west side of the Sierra Madres. Except for Culiacan and Guasave, any source sites have routes that split either east or west of the Sierra Madres. Routes from these two sites generally follow the coast northward, or cross the Sierras directly. This site appears to provide bells by both coastal and inland routes, and is a possible source for the Hohokam. Because Tepic is not a Phase I site, it is possible that it developed through the trade of copper bells northward.

Examination of the Hypothesis

I have been unable to verify that Paquimé was indeed fortuitously located along an established trade route. In fact, I found that the routes used by merchants before the development of Paquimé during the Medio phase were most likely several hundred kilometers east and/or west of Paquimé. Therefore, it is unlikely that Paquimé developed because of close proximity to established trade routes. This disproves my expectation that Paquimé was indeed located in proximity to trade routes established during Phase I, approximately AD 800 - AD 1250. This condition negates my hypothesis that Paquimé developed because of its geographic proximity to one or more pre-Hispanic trade routes, which had been established before its fluorescence.

This study assumes that in the mountainous region of northern Mexico, merchants would utilize the most cost-effective path available. None of the paths passed within 30 km, or a day's walk, to Paquimé. Such proximity would have potentially caused it to develop as a major component of the exchange network. Therefore, the data do not bear up the hypothesis that Paquimé developed because of its proximity to established trade paths. Paquimé developed into a large polity with access to exotic goods and the ability to create architecture on a grand scale in the style of their Mesoamerican neighbors to the south. These results of my research indicate that there is another reason or reasons for the development of Paquimé.

Conducting this research is important because it provides a means for examining the development of polities in isolated regions. It illuminates ways in which goods were moved across great distances and the relationships between people through time. The relationship between the geographical locations and the people who moved goods between them was certainly complex and fluid. This cost-path analysis is a baseline from which additional research may be undertaken. For this research project, the results may have been adversely affected by error. If in fact this hypothesis is correct, other factors may be involved which led to errors in the analysis process. The primary cause of this could be the large cell size of the DEM I used. Because each cell was 868 meters, the value each was given may not be refined enough to show the same cost path that would be generated by a DEM with larger scale. In fact, one way to check this would be to overlay a large-scale DEM (30 m) on the base DEM in order to verify its accuracy. Another aspect to consider when conducting the analysis, especially in the arid desert region of this study, is the correlation of water to the paths. The actual paths may deviate from the cost-effective path in order to stay close to a

water supply. By the same token, the study area is made up of ecologically diverse regions. There are mountains, a desert, a lush coastline, and a piedmont. The eastern piedmont is made up of fertile grasslands with trees – a much more inviting environment for long-distance travel than an arid desert, and less physically taxing than traversing mountain ranges.

It is certainly possible that my hypothesis, while reasonable, was incorrect. While I still believe that inter-regional trade was a catalyst for Paquimé's development, its presence on an established trade route may not have provided the stimulus for its growth. Other, unrecognized factors may have affected Paquimé in such a way that it developed beyond the scope of other sites in that remote area.

The fact remains that Paquimé developed into an important polity in a remote area; therefore, I will explore some alternative possibilities which may have affected the development of Paquimé in the following discussion.

Alternative explanations for the development of Paquimé

During Phase II (AD 1250 - AD 1520), all of the bells used in this analysis were found in the Southwest United States as well as at Paquimé. Because of the quantity of these bells in Paquimé, archaeologists believe that it was likely a center of redistribution for these and other goods. Because of this, all of the bells in Phase II are thought to have passed through Paquimé on their way to sites in the Southwestern United States. Interestingly, the cost-path analysis indicates that only those paths that originated in Zapé passed through Paquimé and onto other sites.

During the Viejo period, there was nothing (obvious) to set Paquimé apart from any of its neighbors. However, an increase in population, possibly due to an increase in food production and increased immigration, catapulted Paquimé forward in its development. The influx of people brought new ideas and new architectural styles. As Paquimé grew, it developed the trappings of a large, influential polity – ostentatious earthen mounds sprang up, ball courts were built, and the people began to obtain items ostensibly for trade. Shell was brought in and warehoused. Not previously an important commodity to the people of Paquimé, it came to signify their place in the networks of exchange. The people raised macaws in captivity to provide religious paraphernalia to practitioners of the Katsina cult in the northern Southwest. Bells were funneled through Paquimé from the south.

While not fortuitously located on an optimal trade path, there may have been other reasons that prestige goods found their way into and through Paquimé. The source and user sites of the copper bells changed between Phase I and II. This shift in sites, both Mexican and Southwestern, indicates that this region experienced an upheaval, likely caused by the movement of people en masse. It is for that reason Paquimé prospered.

One possibility is that there exists a third site (Fig. 4.12), located roughly between Zapé, Durango and Paquimé, Chihuahua. It would have served as a stop along a trade route that traversed the eastern base of the Sierra Madres. My research indicates that Zapé is a source of copper bells during Phase II. Its location south of Paquimé along the eastern flank of the Sierra Madres indicates to me that while Southwestern influences were extending south, the copper-producing sources of West Mexico were extending northward. I think it would be advantageous to examine this further, and also to identify any possible trade partners located between Zapé and Paquimé.

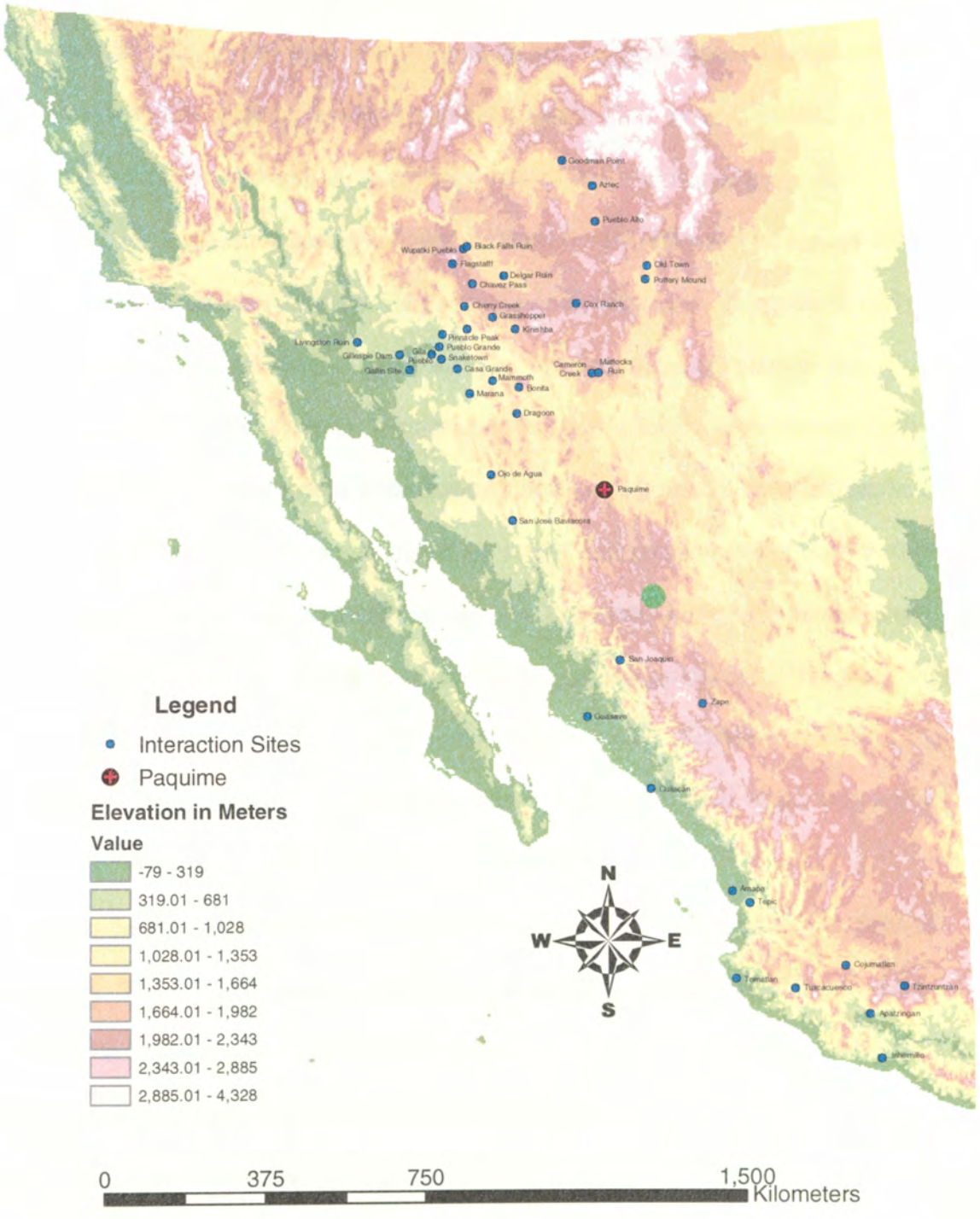


Figure 4.12: Area of presumed site between Paquime and Zape

I postulate that there may be another site between the two that would have facilitated the movement of copper exchange goods and other items from Mesoamerica into Paquimé and further north. The optimal trade route from Zapé into Paquimé passes through alternately high and low altitudes. This site would be an advantageous place to stop, because of its location between Zapé and Paquimé, and also because of the local topography. An individual walking north from Zapé would descend into a valley then ascend again into another mountainous area before descending once more into Paquimé. A traveler could rest at this site before ascending into the mountainous region that separates Paquimé from Zapé.

A second possibility is that the trade routes were not as simple as a pathway connecting two points. Other modes of trade may have been utilized which would explain the presence of the exotica in Paquimé. There are several recognized types of trade including reciprocity, down-the-line, and freelance. Reciprocity is the term to describe an exchange network in which the end user goes to the source of the good or goods. John Douglas (2000) has identified this as the method in which Paquimé acquired shell. Emissaries or "representatives" from Paquimé traveled to the coast to retrieve the shell which was worked and later traded (Renfrew and Bahn 2000:368).

Down-the-line trade involves the movement of goods through a successive chain of trade partners. This pattern would not require an individual merchant or emissary to carry the trade goods from the source to all end users. As the goods traveled, each successive trade partner kept a portion for themselves before passing the rest on.

Freelance, or middleman, trade is conducted by a third party who is neither the source nor the end user. As the name implies, a middleman transports and trades the goods between

the source and end user. This person is not under the obligation of either party, and travels from place to place selling goods through bargaining (Renfrew and Bahn 2000:368).

Any of these modes of trade may have been used by Paquimé or those involved in trade with Paquimé. It is likely that multiple modes were used in conjunction with one another, and that variations of them also occurred. It may be difficult to unequivocally identify individual modes of trade in the archaeological record, except for the down-the-line method (Renfrew and Bahn 2000:369). Regardless of the mechanism, goods traveled across the landscape in such a way that Paquimé had access to them.

The most plausible explanation is that as Paquimé developed, its importance within the sphere of long distance exchange may have superseded the need for it to exist on or near an established trade route. Paquimé developed and shifted from a peripheral site with little or no exotica into a core zone with large amounts of exotica pouring through it. The cause of this shift was likely the long-distance trade that Paquimé participated in. During Phase I, we see that exotic goods are flowing into the American Southwest from Mexico, without much affect on Paquimé.

As a peripheral site in Phase I, internal pressures such as population growth may have led to localized factionalism and the attempt by individuals to obtain power. This could be accomplished through the manipulation of trade goods, especially exotic goods procured from long distances. This would lead to increased competition and factionalism. The archaeological record indicates that factionalism had occurred in Paquimé, as discussed earlier. Ball courts, roasting pits, and localized workshops where trade goods were made, or in the case of macaws, raised, are indicators that individuals were able to obtain non-local goods and become involved in a larger trade network. Through this long distance trade,

Paquimé connected to a larger world, to which it had previously been peripheral. As it participated in the larger trade network, Paquimé became part of the 'world system' of the Southwest and Mexico. This activity would also explain the presence of both Mesoamerican and Southwestern influences in Paquimé.

During Phase II, as the people of the region found it necessary to adapt to climatic changes, Paquimé was developing as a major source for exotica such as shell and macaw feathers. Through their interactions with the south, they were also able to develop as an exchange partner for copper bells as well. This opportunity to control the movement of exotic goods into the Southwest enabled Paquimé to develop as a core zone. Because of its importance as a core, Paquimé would not have to be located along an optimal trade route. Similar to this model is the conclusion reached by Whalen and Minnis (2000, 2001) concerning Paquimé's role. They posit that Paquimé was the center of a "major regional system" that existed in the Southwest and northern Mexico (Whalen and Minnis 2000:168, 2001:4-5).

In conclusion, the development of Paquimé from a small pueblo into the largest polity in the area has been plausibly dated, corresponding to events in the larger region. For example, the large scale architecture and earthworks such as effigy mounds and ball courts built at Paquimé coincide with a movement in the Southwest of people farther south as they tried to find hospitable places to live at the onset of an intense drought. The advent of metallurgical knowledge in which alloys were purposely utilized in copper goods helped define a time frame for specific bell types which are found throughout northern Mexico and the American Southwest, a factor which simplifies tracing copper bells and other similar items through time and space. The quantity of macaw remains, as well as the remains of

aviculture-associated activities in the archaeological record support the theory that Paquimé was indeed part of a larger exchange network, and most likely functioned as a supplier or middleman of religious goods to the Southwest.

Chapter 5: Conclusion

The basis of this research was to determine if the pre-Hispanic polity of Paquimé developed because of its location on likely trade routes. I felt that its growth and development was the result of its geographic proximity to established trade routes between West Mexico and Southwest United States. In order to test this hypothesis, I conducted a cost-surface analysis using GIS to determine the location ofpotential trade paths. Through analysis of the cost paths that I generated, I determined that this hypothesis was unsupported by my research. Paquimé was not located in proximity to any of the likely trade routes that existed before its fluorescence. Therefore, continued research is needed to further clarify the results that I have found in this study.

First, it will be important to verify the results of the cost-surface analysis. This can be done by using a high-resolution overlay with the original 868 m DEM. Paths created on the high-resolution DEM should be compared to those paths in the same area as the original DEM to establish the accuracy of my results.

Further research would entail field work designed to locate and possibly identify the paths. Comparing the generated cost-paths with known features such as small villages or shrines can aid in determining the actual location of these cost paths. Prehistoric pathways used for long distance travel and transportation were little more than "swales" that had been cleared of rubble and debris. The rubble found along the sides of these paths is characteristically rocks and pot fragments (Kantner 2004). Once the general location of the paths was determined, they could be accurately identified by linear artifact scatters.

Examination of local patterns of exchange is another avenue of research. Identifying the patterns of exotica in and around the core areas of Paquimé will elucidate the mode or

modes of distribution that occurred there. Incorporating the exchange patterns between Paquimé and sites such as Arroyo la Tinaja will prove valuable as well. Arroyo la Tinaja is located in a valley of the Sierra Madres. It is an area with a large population contemporaneous to Paquimé. Whalen and Minnis have identified it as a "major corridor of movement" from Paquimé into the Sierra Madres (Whalen and Minnis 2000:178). Identification and examination of trade relations between Paquimé and Arroyo la Tinaja would illuminate the mechanisms through which Paquimé participated in long-distance trade.

Continued work on this research project should include a combination of GIS applications and traditional archaeological field work. GIS can be used to narrow the scope of the investigation through identification of the most cost-effective routes. These routes shall then be compared to known archaeological features such as shrines and villages. Once the location of a path has been reasonably identified, 'ground truthing' will be accomplished through traditional field work methods. Additional field work at Paquimé itself and in the periphery will certainly increase the amount of knowledge we can glean from the archaeological record. Establishing firm peripheral bounds will allow us to accurately estimate the area of Paquimé's immediate influence, as well as indicate the level of political and social development achieved at its apogee.

Bibliography

Blanton, Richard E., Gary M. Feinman, Stephen A. Kowalewski, and Peter N. Peregrine
1996 "A Dual Processual Theory for the Evolution of Mesoamerican Civilization." In *Current Anthropology,* 37:1-14.

Bourdieu, P
1977 Outline of a Theory of Practice. Translated by R. Nice, Cambridge University Press, Cambridge.

Bradley, Ronna J.
1993 "Marine Shell Exchange in Northwest Mexico and the Southwest." In *The American Southwest and Mesoamerica: Systems of Prehistoric Exchange,* edited by Jonathon E. Ericson and Timothy G. Baugh, pp. 121-151. Plenum Press, New York and London.

Bradley, Ronna J.
2000 "Networks of Shell Ornament Exchange: A Critical Assessment of Prestige Economies in the North American Southwest." In *The Archaeology of Regional Interaction: Religion, Warfare, and Exchange across the American Southwest and Beyond,* edited by Michelle Hegmon, pp. 167-187. The University Press of Colorado, Boulder.

Brumfiel, Elizabeth
1992 "Breaking and Entering the Ecosystem: Gender, Class and Factions Steal the Show." In *American Anthorpologist,* 94:551-67.

Camilli, Eileen L. and Linda S. Cordell
1983 Remote Sensing: Applications to Cultural Resources in Southwestern North America, Supplement No. 8. National Park Service, Washington, D.C.

Carmack, Robert M., Janine Gasco, and GaryGary H. Gossen
1996 The Legacy of Mesoamerica: History and Culture of a Native American Civilization. Prentice Hall, Upper Saddle River, NJ.

Di Peso, Charles C.
1974a Casas Grandes: A Fallen Trading Center of the Gran Chichimeca. Vols. 2,6,7,8. Northland Press, Flagstaff.

Douglas, John E.
2000 "Exchanges, Assumptions, and Mortuary Goods in Pre-Paquimé Chihuahua, Mexico." In *The Archaeology of Regional Interaction: Religion, Warfare, and Exchange across the American Southwest and Beyond,* edited by Michelle Hegmon, pp. 189-208. The University Press of Colorado, Boulder.

Feinman, Gary M.
2000 "Dual Processual Theory and Social Formations in the Southwest." In *Alternative Leadership Strategies in the Prehispanic Southwest,* edited by Barbara J. Mills, pp 207-224. The University of Arizona Press, Tucson.

Flannery, Kent V.
1972 "The Cultural Evolution of Civilizations." In *Annual Review of Ecology and Systematics* 3:399-426.

Giddens, Anthony
1984 The Constitution of Society: Outline of the Theory of Structuration. University of California Press, Berkeley.

Graves, William M. and Katherine A. Spielmann
2000 "Leadership, Long-Distance Exchange, and Feasting in Protohistoric Rio Grande." In *Alternative Leadership Strategies in the Prehispanic Southwest,* edited by Barbara J. Mills, pp 45-59. The University of Arizona Press, Tucson.

Hargrave, Lyondon L.
1970 "Mexican Macaws: Comparative Osteology and Survey of Remains from the Southwest." University of Arizona Anthropological Paper No. 20. Tucson.

Hopkins, Terence K. and Immanuel Wallerstein and Associates
1982 "Patterns of Development of the Modern World-System." In *World Systems Analysis,* edited by Terence Hopkins, pp 41-82. Sage Publications, Inc. Beverly Hills, New Delhi, London.

Hosler, Dorothy
1988a "Ancient West Mexican Metallurgy: A Technological Chronology." In *Journal of Field Archaeology,* Vol. 15 2:191-217 (Summer).

Hosler, Dorothy
1988b "Ancient West Mexican Metallurgy: South and Central American Origins and West Mexican Transformations." In *American Anthropologist,* New Series, Vol. 90 4:832-855 (December).

Kantner, John
1997 "Ancient Roads, Modern Mapping: Evaluating Chaco Anasazi Roadways Using GIS Technology." In *Expedition*, Vol.39:3:49-62.

Kantner, John
2003 The Pueblo Southwest. Cambridge University Press. Cambridge, New York, Melbourne.

Kantner, John
2004 "Geographical Approaches for Reconstructing Past Human Behavior from Prehistoric Roadways." In *Spatially Integrated Social Science: Examples in Best Practice,* edited by Michael F. Goodchild and Donald G. Janelle, pp. 323-344. Oxford University Press.

Kelley, J. Charles
1995 "Trade Goods, Traders and Status in Northwestern Greater Mesoamerica." In *The Gran Chichimeca: Essays on the Archaeology and Ethnohistory of Northern Mesoamerica,* edited by Jonathan E. Reyman, pp 103-172. Avebury Ashgate Publishing, Ltd., Aldershot Great Britain, Brookfield VT.

Layton, Robert
1997 An Introduction to Theory in Anthropology. Cambridge University Press. Cambridge, New York, Melbourne.

Lekson, Stephen H.
1991 "Settlement Patterns and the Chaco Regional System." In *Chaco and Hohokam: Prehistoric Regional Systems in the American Southwest,* edited by Patricia L. Crown and W. James Judge, pp. 31-56. School of American Research Press, Santa Fe, NM.

Lekson, Stephen H.
1999a *The Chaco Meridian: Centers of Polictical Power in the Ancient Southwest.* Altimira Press, Walnut Creek, CA.

Lekson, Stephen H.
1999b "Was Casas a Pueblo?" In *The Casas Grandes World,* edited by Curtis F. Schaafsma and Caroll L. Riley, pp. 84-92. University of Utah Press.

Lo, Chor Pang and Albert K. W. Yeung
2002 Concepts and Techniques of Geographic Information Systems. Prentice Hall, Inc. Upper Saddle River, NJ.

McGuire, Randall
1993 "The Structure and Organization of Hohokam Exchange." In *The American Southwest and Mesoamerica: Systems of Prehistoric Exchange,* edited by Jonathon E. Ericson and Timothy G. Baugh, pp. 95 -119. Plenum Press, New York and London.

McKusick, Charmion R.
2001 "Southwest Birds of Sacrifice." In *The Arizona Archaeologist,* Arizona Archaeological Society. 31 July.

Mills, Barbara J.
2000 "Alternative Models, Alternative Strategies: Leadership in the Prehispanic Southwest." In *Alternative Leadership Strategies in the Prehispanic Southwest,* edited by Barbara J. Mills, pp 3-18. The University of Arizona Press, Tucson.

Neitzel, Jill
1989 "Regional Exchange Networks in the American Southwest: A Comparative Analysis of Long-Distance Trade." In *The Sociopolitical Structure of Prehistoric Southwestern Societies,* edited by Steadman Upham, Kent G. Lightfoot, and Roberta A. Jewett, pp 149-195. Westview Press, Boulder San Francisco, and London.

Nelson, Richard S.
1986 "Pochtecas and Prestige: Mesoamerican Artifacts in Hohokam Sites." In *Ripples in the Chichimec Sea: New Consideration of Southwestern – Mesoamerican Interactions,* edited by F. J. Mathien and R. H. McGuire, pp 154-182. Southern Illinois University Press, Carbondale.

Pendergast, David
1962 "Metal Artifacts in Prehispanic Mesoamerica." In *American Antiquity,* Vol. 27:4:520-545.

Renfrew, Colin and Paul Bahn
2000 Archaeology: Theories Methods and Practice. Thames and Hudson, Inc., London, New York.

Service, Elman R.
1975 Origins of the State and Civilization: The Process of Cultural Evolution. W. W. Norton, New York.

Tobler, Waldo
1993 Three Presentations on Geographical Analysis and Modeling: Non-Isotropic Modeling, Speculations on the Geometry of Geography, Global Spatial Analysis. Technical Report 93-1. University of California, Santa Barbara.

Vargas, Victoria D.
1995 "Copper Bell Trade Patterns in the Prehispanic U.S. Southwest and Northwest Mexico." In *Arizona State Museum Archaeological Series 187,* Arizona State Museum. The University of Arizona Press.

Vargas, Victoria D.
1999 "Copper, Ritual, and Power at Paquimé: An Alternative Interpretation for the Significance and Role of Copper Items." From http://www.unm.edu/~paquimé/vargas/saa99/coprit.html. Accessed 11-19-2002.

Wallerstein, Immanuel
1982 "World-Systems Analysis: Theoretical and Interpretative Issues." In *World Systems Analysis*, edited by Terence Hopkins, pp 91-103. Sage Publications, Inc. Beverly Hills, New Delhi, London.

Whalen, Michael E. and Paul E. Minnis
2000 "Leadership at Casas Grandes, Chihuahua, Mexico." In *Alternative Leadership Strategies in the Prehispanic Southwest,* edited by Barbara J. Mills, pp 168-179. The University of Arizona Press, Tucson.

Whalen, Michael E. and Paul E. Minnis
2001 Casas Grandes and its Hinterland. The University of Arizona Press, Tucson.

Whitecotton, Joseph W. and Richard A. Pailes
1986 "New World Precolumbian World Systems." In *Ripples in the Chichimec Sea: New Considerations of Southwesern-Mesoamerican Interactions,* edited by Frances Joan Mathien and Randall H. McGuire, pp 183-204. Southern Illinois University Press, Carbondale and Edwardsville IL.

Wright, Henry T. and Gregory A. Johnson
1975 "Population, Exchange, and Early State Formation in Southwestern Iran." In *American Anthropologist,* 77:267-89.