

Impacts of Climate Variability on Pre-Hispanic Settlement Behavior in South Peru

***The Northern Río Grande de Nasca Drainage between
1500 BCE and 1532 CE***

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Volker Soßna

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1. Gutachter: Prof. Dr. Johannes Müller

2. Gutachter: Prof. Dr. Ingmar Unkel

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gez. Prof. Dr. Wolfgang J. Duschl, Dekan

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für meine Familie

to my family

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Abstract

The Central Andean coast and the adjacent highlands were a core area for the development of complex societies in the Americas. In this region, a multitude of different environments, each offering a distinct set of exploitable resources, can be found within close proximity. As a result, complex human-environmental relationships developed, which can be regarded as a prerequisite for the manifold cultural achievements of the local pre-Hispanic peoples. The arid climate of the Andean west flank, however, makes water for valley floor irrigation a scant resource and also limits rain-fed agriculture. Likewise, at high altitudes, frosts are a limiting factor. Since already slight absolute fluctuations in precipitation and temperature patterns can significantly alter the potential of agricultural production, several scholars have proposed that climate change may have had a crucial impact on cultural development. The evidence presented in support for this hypothesis is nevertheless often tenuous or ambiguous.

In the present study, pre-Hispanic settlement patterns in the northern Río Grande de Nasca drainage in south Peru (14.5°S) were analyzed and compared for ten cultural phases between 1500 BCE and 1532 CE. By doing so, major changes in settlement structure, the spatial distribution of settlements, socio-political organization, population levels, and general culture were traced. The corpus of data comprised 787 archaeological sites with settlement remains recorded during 15 years of fieldwork by the *Palpa Project*, a joint project of the *German Archaeological Institute* and the Peruvian *Andean Institute for Archaeological Studies*. Based on this material, 1042 settlements were defined and classified according to phase, size, and rank in a settlement hierarchy. A complex database was designed to hold and manage this information but also to perform a variety of statistical calculations allowing for inter-phase comparison. This database was linked to a geographic information system (GIS), in which spatial analyses were performed, such as the calculation of walking time distances and altitudes relative to the nearest valley floor. Furthermore, the GIS was used for designing distribution maps.

The results of this analysis were compared to a reconstruction of the paleo-climate based on previous studies of local and remote geoarchives carried out by different teams of scientists. By doing so, it was possible to check for temporal correlations between climate change and cultural development. It has been found that during several periods climatic conditions seem to have operated as an amplifier for socio-political processes. In turn, there also seem to have been examples for cultural climaxes under comparatively unfavorable climatic conditions and of severe crises when climate was favorable. This find implies that while climate surely had an impact on cultural development there was no strict causal link between these phenomena. Precipitation amounts only rarely seem to have dropped to a degree where agricultural productivity would have been dramatically lowered for a longer period, causing severe crises to local peasant societies. Given that both the archaeological and the paleo-climatic data show gaps and are of limited temporal resolution it can nevertheless not be ruled out that many short-term correlations between precipitation and cultural development have not been detected. Since no published local high-resolution proxy records are currently available for temperatures, it is also possible that future studies will show that agriculture and settlement history in the highlands were affected significantly by fluctuations in the frequency of frost events. New data gathered by ongoing and future studies will show whether the general trends outlined in the present thesis can be confirmed by more detailed analyses.

Zusammenfassung

Der zentral-andine Küstenstreifen und das angrenzende Hochland waren ein Kerngebiet für die Entwicklung komplexer Gesellschaften in Amerika. Charakteristisch für diese Region ist die räumliche Nähe einer Vielzahl unterschiedlicher Naturräume, von denen jeder eine spezifische Auswahl nutzbarer Ressourcen bietet. Dementsprechend haben sich komplexe Mensch-Umwelt-Beziehungen herausgebildet, die als eine Voraussetzung für die vielfältigen kulturellen Errungenschaften der lokalen vorspanischen Völker angesehen werden können. Das trockene Klima der andinen Westflanke lässt jedoch Wasser zur Bewässerung oder für regenabhängigen Feldbau zu einer knappen Ressource werden. In großer Höhe sind Fröste ein ebenfalls limitierender Faktor. Da bereits leichte absolute Schwankungen der gewöhnlichen Niederschlagsmengen und Temperaturen das Potential der landwirtschaftlichen Produktion erheblich verändern können, vermuten eine Reihe von Forschern, dass Klimaänderungen einen entscheidenden Einfluss auf die Kulturentwicklung gehabt haben könnten. Die zur Stützung dieser Hypothese vorgebrachten Beweise sind jedoch häufig dünn oder uneindeutig.

In der vorliegenden Studie wurden die vorspanischen Siedlungsmuster im nördlichen Flusssystem des Río Grande de Nasca in Süd-Peru (14.5°S) analysiert für zehn Kulturphasen zwischen 1500 v.Chr. und 1532 n.Chr. verglichen. Dadurch konnten wichtige Veränderungen in den Siedlungsstrukturen, der räumlichen Siedlungsverteilung, der sozio-politischen Organisation, der Bevölkerungsdichte und der Kultur im Allgemeinen nachvollzogen werden. Der Korpus umfasste 787 archäologische Fundstätten mit Siedlungsresten, die in 15-jähriger Feldarbeit vom Palpa Projekt, einem Kooperations-Projekt des *Deutschen Archäologischen Instituts* und des peruanischen *Andinen Instituts für Archäologische Studien*, dokumentiert worden waren. Auf diesem Material basierend wurden 1042 Siedlungen definiert und nach Zeitstellung, Größe und Rang innerhalb einer Siedlungshierarchie klassifiziert. Eine komplexe Datenbank wurde entworfen, um diese Informationen zu speichern und zu verwalten, aber auch, um diverse statistische Berechnungen durchzuführen, die einen Vergleich der Zeitphasen ermöglichten. Diese Datenbank wurde mit einem geographischen Informationssystem (GIS) verknüpft, in dem räumliche Analysen wie die Berechnung von Wanderzeit-Distanzen und Höhenlagen relativ zum nächstgelegenen Talboden durchgeführt wurden. Außerdem diente das GIS der Erstellung von Verteilungskarten.

Die Ergebnisse dieser Analyse wurden mit einer Rekonstruktion des Paläo-Klimas verglichen, die auf vorangegangenen Studien verschiedener Teams von Naturwissenschaftlern zu lokalen und entfernten Geoarchiven basiert. Dadurch konnte geprüft werden, ob Klimaänderungen mit Kulturentwicklungen zeitlich korrelieren. Dabei wurde festgestellt, dass das Klima während mehrerer Zeitphasen als Verstärker sozio-politischer Prozesse gewirkt hat. Dagegen gibt es aber auch Beispiele für kulturelle Blütezeiten unter vergleichsweise widrigen Klimabedingungen und für schwere Krisen als das Klima günstig war. Dieser Befund impliziert, dass, obwohl das Klima sicherlich Auswirkungen auf die Kulturentwicklung hatte, dennoch kein strikter kausaler Zusammenhang zwischen beiden Phänomenen bestanden hat. Die Niederschläge scheinen nur selten in einem Ausmaß zurückgegangen zu sein, bei dem die landwirtschaftliche Produktion über einen längeren Zeitraum drastisch eingeschränkt gewesen wäre, was zu schweren Krisen für die lokalen bäuerlichen Gesellschaften geführt hätte. Da sowohl die archäologischen als auch die paläoklimatischen Daten lückenhaft und von begrenzter zeitlicher Auflösung sind, kann dennoch nicht ausgeschlossen werden, dass viele kurzfristige Korrelationen zwischen Niederschlag und Kulturentwicklung nicht erkannt wurden. Da zurzeit noch keine hochauflösenden lokalen Proxy-Daten für Temperaturen publiziert vorliegen, ist es außerdem möglich, dass zukünftige Studien zeigen, dass die Landwirtschaft und die Siedlungsgeschichte im Hochland ernsthaft von Schwankungen in der Häufigkeit von Frostereignissen beeinträchtigt wurden. Neue, im Rahmen laufender und zukünftiger Studien gesammelte Daten werden zeigen, ob die in dieser Arbeit skizzierten generellen Tendenzen durch detailliertere Analysen bestätigt werden können.

General Notes

Terminology Referring to Dates

In the following, dates are given in years *Before Common Era* (BCE) and *Common Era* (CE), respectively. The scale is identical with the BC/AD system but avoids reference to Christian religion. Broad chronological units are referred to as *periods* while their subdivisions are termed *phases*. When ages, usually derived from ^{14}C measurements, are given in calendric years the term *numeric date* will be used. In archaeology, the expression *absolute date* is more common, but most scientists are critical about the denotation and point out that *numeric* is more adequate, because *absolute* suggests a definite certainty that no measurement can ever generate.

Citations

Indirect in-text citations consist of the author's last name followed by the year of publication. The full bibliographic information is given in the references section. In case of more than two authors, only the last name of the first author with the suffix *et al.* is given. If several works from different authors are cited, they are ordered alphabetically by the authors' last names and then by the year of publication. If several works from the same author are cited, the author's last name is given only once, followed by the years of publication in ascending order separated by a slash (e.g., "Smith 1999/2001/2005"). References to pages follow the year of publication of the cited work and are separated by a colon (e.g., "Smith 2001:45-67"). In case of quotations, only the year and the page range are given in brackets if the author is mentioned in the preceding sentence (e.g., "(1998:45-67)").

The authors of figures and maps are indicated in the respective caption. I used my initials "VS" to indicate my own authorship. Figures and maps taken from the official documentation of the Palpa Project can generally not be assigned to a specific author and are therefore cited as "Palpa Project."

Maps

If not indicated otherwise, all maps are based on the World Geodetic System from 1984 (WGS84) and are projected to Zone 18 South of the Universal Transverse Mercator System (UTM). For overview maps on a continental or sub-continental scale, coordinate labels of the grid are given in degrees. Maps limited to the study area and its surroundings have an UTM grid. Some of the latter, namely the settlement pattern maps, are rotated by 45° to better fit to the A4 page format and thus do not face north but northeast.

Location of Figures and Maps

For technical reasons, page-size figures and maps were placed at the end of the chapter or subchapter in which they are first mentioned. All other illustrations appear close to the paragraph in which they are first referenced. Illustrations are numbered in the order of their appearance in the document and not in the order of their first reference in the text. As a consequence, a reference to Map 3, for example, may precede the first reference to Map 2.

Units

All distance, area, and volume units refer to the metric system: millimeters (mm), centimeters (cm), meters (m), kilometers (km), square meters (m^2), hectares (ha), and cubic meters (m^3). Temperatures are given in degrees Celsius ($^\circ\text{C}$).

1 Introduction

One of the most outstanding properties of the species *Homo sapiens sapiens* is its capability to adapt to almost all environments on the planet. This is true even in the most extreme cases, as for example, hyper-arid deserts. Fashioning a livelihood and developing a flowering culture in such a region counts as a highly astonishing and impressive achievement for human kind. Including all the deserts on Earth, the one along the Central Andean Pacific coast is among the driest. For thousands of years, it has nevertheless also been one of the most densely settled. The study area of the present thesis forms part of this fascinating desert strip: the northern Río Grande de Nasca drainage at the foot of the Andean west flank in southern Peru. The drainage comprises a couple of minor streams running from the mountains most of which only carry water during a few months of the year. Today, two small towns - Palpa in the northern and Nasca in the southern part of the drainage - are the local centers in regards to politics, economy, and culture. Nasca has reached considerable prosperity during the last decades. Much of the recent wealth comes from the flourishing tourist industry, which profits greatly from the widespread fascination with the famous "Nasca Lines." The German mathematician Maria Reiche dedicated her life to the conservation and promotion of the giant ancient ground drawings of the Nasca culture (200 BCE-650 CE) that spread across the desert plains. In 1994 she finally achieved that the geoglyphs were declared a world cultural heritage by the UNESCO. The resulting worldwide publicity triggered a tourist boom and increased academic interest in the societies that had once flourished in a region that apparently was not at all favorable to human settling.

The Nasca represent a culture that once thrived over many centuries in an extreme environment. The region had also been inhabited long before the Nasca Period (from at least the fourth millennium BCE onwards) and it remained settled after the Nasca vanished. What happened to the bearers of the Paracas (800-200 BCE), Nasca (200 BCE-650 CE), Wari (650-1000 CE), and Ica (1000-1532 CE) cultures who inhabited the region in their respective epochs? Did they "die out," move away, or simply adopt new ways of life? Having in mind the great monumental city of Tiwanaku close to the Titicaca Lake, John Janusek states in a recent book:

The reasons why civilizations collapse are manifold. We tend to think of collapse as the complete and unfortunate end of a past people. This assumption is continually invoked in popular romantic accounts of the past, including television specials concerned with the "mystery" of Maya collapse or the "discovery" of lost Andean cities. Overly dramatic attempts to box up and sell the past, in most cases a very complex and hazily understood past, mislead. Resonating with our deeply ingrained common sense regarding the past, they promote the idea that such civilizations ended abruptly, taking with them their people and leaving behind only abandoned ruins. Yet the question is not so much what happened to the people— for the distant descendents of many past civilizations continue to thrive around the world—but what happened to the political systems and religious ideals that inspired the exotic, and beautiful monuments that continue to intrigue today. (2008:289)

Natural hazards and climate change are often suspected to have played a key role in both the rise and the decline of past societies all over the world (Clare & Weninger 2010, contributors in Anderson & Maasch et al. 2007). The Central Andes are no exception (Andrus et al. 2008, Binford et al. 1997, Craig 2011, Mächtle & Eitel 2013, Richardson III & Sandweiss 2008). This includes, of course, the Peruvian south coast, although in 1914, Max Uhle, the "father of Andean archaeology," who excavated numerous tombs in the Nasca region still thought otherwise:

To judge from these numerous burials there must have been a dense population in these same regions, and it is difficult to understand by what ways and means they could subsist in this arid land as it appears to us today. The theory that the climate of that region might have undergone a change since those early days, cannot be upheld, since there are no additional circumstances to be found in support of it. (1914:10)

Still in 1965, Paul Kosok, who interpreted the Nasca geoglyphs as astronomical signs¹, assumed that climatic conditions of the past were comparable to today's:

Specific hydrological problems of the Nazca area may have furnished a reason for such elaborate astronomical observations. While the larger rivers in the north have water for a good part of the year, the branches of the Río Grande have water for only about five months. During 'bad' years there is even less water; during 'very bad' years there is none! (1965:58)

¹ Today, the astronomical hypothesis can be regarded as largely refuted. Although some of the ground drawings might have been oriented towards prominent celestial bodies, most were not (Aveni 2000, Hawkins 1974, Lambers 2006).

Many archaeologists working in the Central Andes seem to have become more conscious of climate impacts on cultural development after Lonnie Thompson published his frequently cited 1986 study of an ice drill core from the Quelccaya glacier near Cusco (e.g., Andrus et al. 2008, Dillehay & Kolata 2004, Dillehay 2011, Kolata 1996/2003). From the late 1980s onwards, long-term climate change was discussed more frequently in books and articles aiming at the reconstruction of the fate of ancient societies.² At present, a hundred years after Uhle's skeptical statement, most scholars agree that climate had always been changing on a global and regional scale throughout the past, and that these changes constantly altered the living conditions for human societies. This insight has gained additional relevance due to the pressing problems of today. Over the last two decades, climate change and its consequences for *recent* human societies have become a major topic, and in the course of this discussion the general public has also started to draw attention to the fate of *past* societies, as emphasized by Guy Middleton:

The resurgence of explanations of collapse and historical change as driven primarily by, or profoundly affected by, long-term or abrupt climatic changes that affected the conditions of subsistence and production is unsurprising given current concerns over climate change and global warming [...]. The scientific study of paleoclimatology also has revealed the profound dynamism and instability of local, regional, and global climates in the Holocene and has enabled climatic change to be mapped chronologically with a high degree of precision [...]. Past climate can no longer be assumed to have been identical to today nor to have remained static, and past climate data require consideration and integration into reconstructions of the past [...]. In fact, paleoclimatic studies have already profoundly impacted the study of collapse and culture change, and a new determinism is in evidence. (2012:268)

Nevertheless, most major regional-scale projects specifically designed to investigate the impact of climate change on cultural development are relatively recent and still few in number, at least in the Central Andes. Further studies are needed to join the patches of information from both paleo-climate and human prehistory into a broader frame, which will enable a better understanding of interdependencies and general processes.

1.1 Research Problem

In a tropical desert, the relevance of climate change for human societies lies predominantly in the impact of water availability on food resources. This holds true for mobile hunters and foragers too, but the dependency of settled farmers on regular and sufficient precipitation is even higher. In the Central Andes, the development of agriculture as a *complementary* strategy of food acquisition started during the 10th to 7th millennium BCE (e.g., Pearsall 2008, Rossen 2011), which is long before the introduction of pottery during the first half of the 2nd millennium BCE (Lumbreras 2006). Nevertheless, it was a prolonged and gradual process that led to farming becoming the *dominant* subsistence strategy for most coastal societies. In the Río Grande drainage, there still is a data gap between the archaic occupation of the site of Pernil Alto (approximately 3800-3000 BCE), which already includes evidence of cultivation as a complementary activity, and the earliest sites of the so-called Initial Period, which date to around 1500 BCE. For the Initial Period and all following periods archaeological remains clearly point to a developed full-time agriculture (Reindel & Isla Cuadrado 2006/2009).

Since then, as several studies have shown, the number, size, and location of settlements were subject to frequent and significant changes (Schreiber & Lancho Rojas 2003, Silverman 2002, Reindel 2009, Reindel & Isla Cuadrado 2013). What were the causes of this phenomenon? While there are a number of possible explanations, such as warfare, new social structures, new technologies, migration, or epidemics, the extreme character of the surrounding desert raises the suspicion that climate fluctuations might have had the most crucial impact on the fate of its ancient inhabitants. In particular, any substantial reduction in precipitation would have had far-reaching consequences for rain-fed and irrigation farming, the principal pillars of food production. But how did climate on the one hand and settlement behavior on the other actually change between the beginning of the Initial Period around 1500 BCE and the Spanish Conquest in 1532 CE? Were both phenomena causally linked? In other words, was the south Peruvian desert just another stage for climate-driven tragedies?

² The way in which Thompson's *local* climate proxy records were often used uncritically to interpolate the climate history of almost all of the Central Andes is problematic. As a consequence, many assumptions made by archaeologists concerning correlations between cultural and climate events in regions far away from Quelccaya have to be regarded as doubtful. More recent publications are generally aware of the problem, since interdisciplinary cooperation with paleo-climatologists is becoming a standard.

'Settlement behavior' refers to the locations where and the manner how dwelling sites were established and how these were related to each other. It is only one aspect of a society's culture but it can tell much about subsistence strategies and social structure on a regional scale. As Mark Sutton and Eugene Anderson put it:

Settlement pattern depends on a variety of factors, beginning with the basic economic system used by a group. For example, a hunter-gatherer group would utilize a valley floor quite differently than would a group of farmers, with very dissimilar components, management practices, residential localities, and support facilities. The basic economic system would also influence the types and scales of facilities and technologies employed and the kinds of resources utilized. (Sutton & Anderson 2010:100)

Settlers tend to reside close to the most important resources they use. Fishers can be expected to dwell close to a shore or lake and farmers will probably build their houses next to their most productive fields. If in a wider region all or most villages are being abandoned, possible reasons are the depletion of vital resources, a significant change in subsistence strategies (e.g., fishers becoming farmers), or threats from enemies.

If some settlements comprise special representative architecture and features pointing to administrative functions beyond the village level, a hierarchical relation between such a center and surrounding common villages can be assumed. On a regional and supraregional scale, the degree of political unity or fragmentation may be deducible from such settlement hierarchies. In this way, major changes in the political structure can be recognizable by comparing settlement patterns of different periods. Finally, fluctuations in number and size of simultaneously inhabited villages reflect the development of population levels.

All of these aspects – use of local resources, changing subsistence strategies, population levels, conflict, and political organization – *can* be influenced by climate change, especially in a hyper-arid or otherwise particularly susceptible region. This does not mean that climate change in fact triggered every new development observed in the archaeological record. Cultural aspects like innovation or simply the personal ambitions of individual rulers may also have played a major part. Consequently, the question to be addressed in the present study is:

Were major changes in settlement behavior caused by climate change?

1.2 Approach

Addressing this question requires a reliable reconstruction of both past societies and the environment they inhabited. Paleo-environmental data can be derived from geoarchives and geomorphological analyses while ancient cultures have to be reconstructed on the basis of their material remains by evaluating archaeological data, and, where available, also by interpreting preserved written sources. Only joint research efforts of environmental scientists and archaeologists can produce credible results on questions concerning prehistoric human-environment relationships in general.

It is firstly necessary to clarify what is meant by "climate change" and by "major changes in settlement behavior," respectively. Climate is a complex and multi-faceted matter but regarding its impacts on agrarian societies, three components are especially important as they directly influence the success of crop cultivation. These components are precipitation, temperature, and the variability of these two parameters. Since droughts and frosts can damage plants and reduce yields, agriculture is most productive where water supply is secured and temperatures never drop below 0°C. "Variability" refers to the degree of regularity and thus, to the reliability and predictability, of climate patterns in terms of averages and extremes of precipitation and temperatures. A high variability also means a high risk of crop failure. Major changes in settlement patterns can be asserted with relative confidence if the spatial distribution, the overall settlement area, or the inter- and intra-settlement complexity differs notably between two subsequent chronological phases.

Investigations on the impact of climate change on a local environment should bear good results in regions where fluctuations of precipitation and temperature can be expected to have an especially pronounced effect on the general environment. In these areas it is easier to identify signals in the proxy records. For example, a slight increase in precipitation in a rainforest will probably not significantly change the general environment while the same absolute amount of additional rainfall would have the potential to turn a desert into grasslands. Similarly, high mountain ranges are especially suitable for regional-scale paleo-climatic research because the altitudinal difference between its peaks

and its foothills creates different climatic regimes at relatively close spatial proximity. In consequence, borders and transitions between ecozones are generally sharper than in flat open terrain, such as the Eurasian steppe.

From the archaeological point of view, ideal research conditions for regional studies would include a generally good preservation of material remains and an easy detectability of sites. Both prerequisites can generally be found in arid zones because the dry climate favors the preservation of organic material and because a sparse or even entirely lacking vegetation cover does not hide surface remains. Consequently, many sites, especially those including architectural remains, can be recorded quickly through prospection and survey without excavation. Information gathered that way will nevertheless tend to be coarse and incomplete.

In this sense, the west flank of the Central Andes offers ideal research conditions for paleoclimatologists *and* archaeologists. While the coastal strip forms one of the driest deserts on Earth, the highlands reach altitudes of more than 4000 m.a.s.l. The terrain ascends from sea level to these heights within a very short distance of only 60 to 120 km, resulting in especially pronounced temperature and precipitation gradients. In consequence, numerous different environments form at close proximity. The aridity at the coast and foothills has preserved organic material in archaeological contexts for thousands of years, and at many sites remains of the past lay openly exposed upon the barren ground.

The Ica and Río Grande drainages at the Peruvian south coast are of special importance as these belong to the first areas in the Central Andes that attracted major-scale archaeological research. Max Uhle, pioneer of Andean archaeology, worked here around 1900. In the 1960s, John Rowe and his team developed a pan-Peruvian chronological framework based on data from the Ica valley. Since the 1980s, several projects aim to understand the ancient cultures of the region in a broader context. Since 1997, the *Deutsches Archäologisches Institut* (DAI) and the Peruvian *Instituto Andino de Estudios Arqueológicos* (INDEA) are conducting a major research project in the northern Río Grande de Nasca drainage. Originally, the *Proyecto Nasca-Palpa* was limited to the surroundings of the small town of Palpa and focused on the Nasca culture, especially on the geoglyphs made by the bearers of that culture. Both the chronological scope and the study area soon widened when succeeding projects were set up. By now, the remains of all periods of the pre-Hispanic past found between the junction of the Río Grande and Ingenio rivers up to the water divide at 4400 m.a.s.l. are being documented and analyzed (cf. Reindel & Isla Cuadrado 2013). The data gathered during the 15 years of fieldwork were kindly made available to me for analyses in the scope of the present study. From here on, this long-term archaeological research will be referred to in general as to the *Palpa Project*.

The archaeological works of the Palpa Project have been included in two joint projects with scientists from different disciplines: the *Project Nasca: Development and Adaptation of Archaeometric Techniques for the Investigation of Cultural History* between 2002 and 2007 (Reindel & Wagner 2009) and the *Andean Transect Project* between 2008 and 2011 (Reindel & Isla Cuadrado 2013). They were, however, continuously directed by Markus Reindel (DAI) and Johnny Isla Cuadrado (INDEA). Paleoclimatic and geomorphological research in the Río Grande de Nasca drainage has been carried out by specialists from the Universities of Heidelberg, Cologne, and Jena for more than ten years now (Hesse & Baade 2009, Mächtle & Eitel 2009/2013, Unkel & Kadereit et al. 2007). Based on the results, a model for the climate history of the region has been developed which is constantly being refined. While changes in temperature patterns and inter-annual climate variability have been found difficult to reconstruct, longer periods of increased and decreased aridity could be identified with some confidence.

If major changes in climate and settlement behavior occurred at about the same time, a causal linkage between both phenomena may have existed. Caution is necessary, however, when correlating cultural and geomorphological events. An offset of a century, which is well within the error margin of dating, in some cases might lead to a reversal of many interpretations. Furthermore, non-climatic factors such as the broader political situation and organization or the introduction of new technologies and subsistence strategies also have an impact on settlement patterns. Consequently, a mere chronological coincidence alone does not evidence a causal linkage. Instead, a detailed consideration of the macro-scale cultural, social, and political background is necessary in order to identify possible non-climatic driving forces, which may lead to alternative explanations. Hypotheses in social anthropology, however, are normally not proved right or wrong, simply, but are rather considered for their coherency and persuasiveness. All factors have to be discussed together, and weighed against each other, before an overall picture of the pre-Hispanic settlement history of the study area can be drawn, and before the

points in time when climate actually seems to have been the major driving force behind changes in settlement behavior can be determined.

1.3 Study Area

The Río Grande de Nasca drainage is situated about 15° south of the equator in southern Peru (Map 1). It can be divided into two major branches, each of which fans out into several tributary streams. The northern branch comprises, from east to west, the valleys of Santa Cruz, Río Grande, Palpa, Viscas, and Ingenio. Its provincial capital is the small town of Palpa. This area will be referred to as the northern Río Grande drainage (NGD) from here on. The southern Río Grande drainage (SGD) consists, from north to south, of the valleys of Nasca – which in turn splits into the Aja and the Tierras Blancas tributaries –, Taruga, and Las Trancas. The rivers have their headwaters at an altitude of around 4000 m.a.s.l. where seasonal rainfalls between December and April provoke a temporarily lush shrub and grass vegetation. During their course through narrow valleys down the Andean west flank, the streams cross an ever more arid landscape, which is at first characterized by cacti but finally, below approximately 500 m.a.s.l., is almost completely barren of vegetation. Between the foothills and the Pacific coast stretches a roughly 50 km wide strip of full-blown desert where vegetation is only present in the river valleys. Close to the shore, a coastal cordillera reaching more than 1500 m.a.s.l. blocks most of the fog which in other sections of the Peruvian coast spreads inland from the sea.

The study area is identical with the spatial extension of the surveys carried out by the Palpa Project in the northern Río Grande de Nasca drainage. It extends from the confluence of the Río Grande and Ingenio rivers at 200 m.a.s.l. up to the water divide around *Cerro Llamocca* at 4424 m.a.s.l. It comprises the northern section of the Río Grande valley up to approximately 1100 m.a.s.l. as well as the complete valleys of the Palpa and Viscas rivers, including the wider valley margins and the mountainous areas between them. At the foothills, the Río Grande, Palpa, and Viscas valleys join into an extended floodplain in which the town of Palpa is located. Immediately upstream, the Grande and Palpa valleys are divided by a narrow ridge, the *Cresta de Sacramento*, which gradually becomes broader and higher before finally ascending up to the peak of *Cerro Pinchango* (1089 m.a.s.l.), the most elevated point of the surrounding area. In turn, the Palpa and Viscas valleys are divided by *Cerro Carapo* (648 m.a.s.l.). The Pan-American Highway crosses the region, connecting the present-day foothills settlements of Santa Cruz, Palpa, and Llipata. In the highland section, a secondary gravel road leads from Huac Huas over Llauta, Laramate, and Ocaña to Otoa. Additional secondary roads follow the valley margins to connect the foothills with the highlands.

1.4 Data

During 15 years of fieldwork, the Palpa Project has documented 1155 archaeological sites of all pre-Hispanic periods of which 835 contain remains of dwellings and related domestic activities. Several dozens of these sites have been test pitted and seven have been excavated on a larger scale. Most of the surveys and excavations were directed by Johny Isla Cuadrado and Carolina Hohmann who also are the authors of the major part of the original site descriptions, sketches, and photos. Additionally, I revisited most of these sites myself in order to get a direct personal impression and to complement or clarify data where necessary.

Archaeological data analyses have so far concentrated on some especially important sites where major excavation had taken place (Isla Cuadrado et al. 2003, Reindel 2009, Reindel & Isla Cuadrado 2001/2006/2009/2013). Additionally, some summarizing overviews over the diachronic development of settlement patterns have been published (Isla Cuadrado & Reindel 2005, Reindel 2009, Reindel et al. 1999, Reindel & Isla Cuadrado et al. 2010, Reindel & Isla Cuadrado 2013). An in-depth analysis incorporating and comparing occupations of all sites from all phases has nevertheless not yet been undertaken. The present study, based on the survey and excavation data of the Palpa Project made available to me by its directors Markus Reindel and Johny Isla, is intended to fill this gap. The full amount of archaeological data from all pre-Hispanic phases offers perfect conditions for a detailed diachronic reconstruction of settlement patterns. Published data from other parts of the Río Grande drainage, namely from its southern tributaries, and from neighboring regions are also considered for

comparison. Combining a profound study of archaeological settlement data with the paleo-environmental reconstruction developed by research groups from Heidelberg, Cologne, Jena, and Kiel Universities surely has the potential to answer the question, if and when major changes in settlement behavior were caused by climate change.

1.5 Chapter Organization

Investigations on human-environment relationships in a particular study area can best be understood in the wider natural and cultural context. This is especially true for the Central Andes where very different environments can be found at close proximity and where, throughout prehistory, most peoples had cultural, economic, social, and sometimes political ties to other groups living hundreds or even thousands of kilometers away. Accordingly, the following two chapters are dedicated to a summarizing introduction to the environment and the pre-Hispanic cultures of the Central Andes in general and of the study area and directly neighboring regions in particular.

Chapter 2 – *Nature* – is split into three parts. The first part describes the study area and its natural resources in some detail while the second part treats the characteristics of the Central Andean climate and outlines the current reconstruction of past climate changes. This reconstruction is based on geomorphological evidence from the Palpa area itself, complemented by the interpretation of proxy data from remote geoarchives reflecting the supra-regional context. The third part compares different approaches to an environment classification.

Chapter 3 – *Culture* – summarizes previous archaeological research, particularly the works at habitation sites in the Río Grande drainage. Subsequently, an overview of cultural development on the southern Peruvian coast and the adjacent highland regions is given, which is structured by broad chronological periods.

Chapter 4 – *Culture Meets Nature* – contains the theoretical approach to human-environment relationships with special consideration for the unique natural setting of the Central Andes. Although such relations are manifold, the economic dimension is most important. It comprises the use of natural resources by humans for their subsistence. This aspect can best be studied by an analysis of material remains, including ancient settlements. Additionally, the effects of climate change on the limits of ecological zones and the agricultural potential will be discussed more specifically for the study area. Finally, the impact of fluctuations of the principal climatic parameters – precipitation, temperature, and variability – on rain-fed and irrigation farming will be discussed and described in eight hypothetical scenarios.

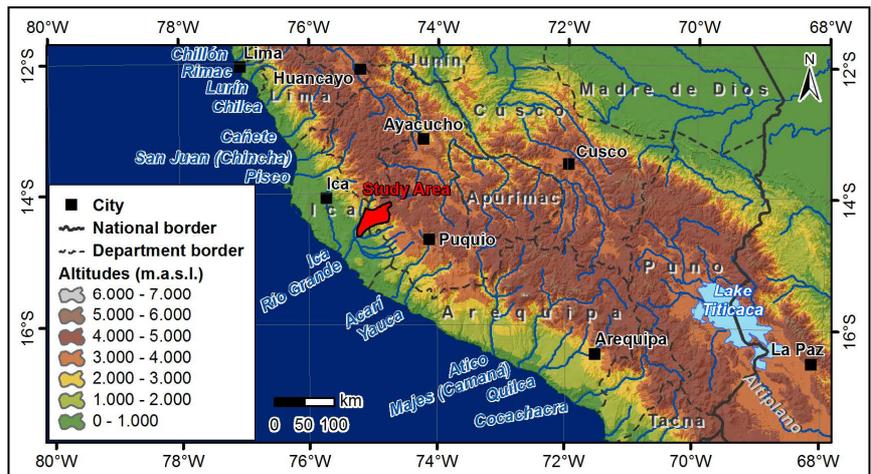
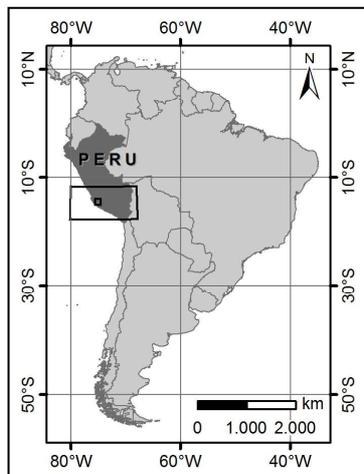
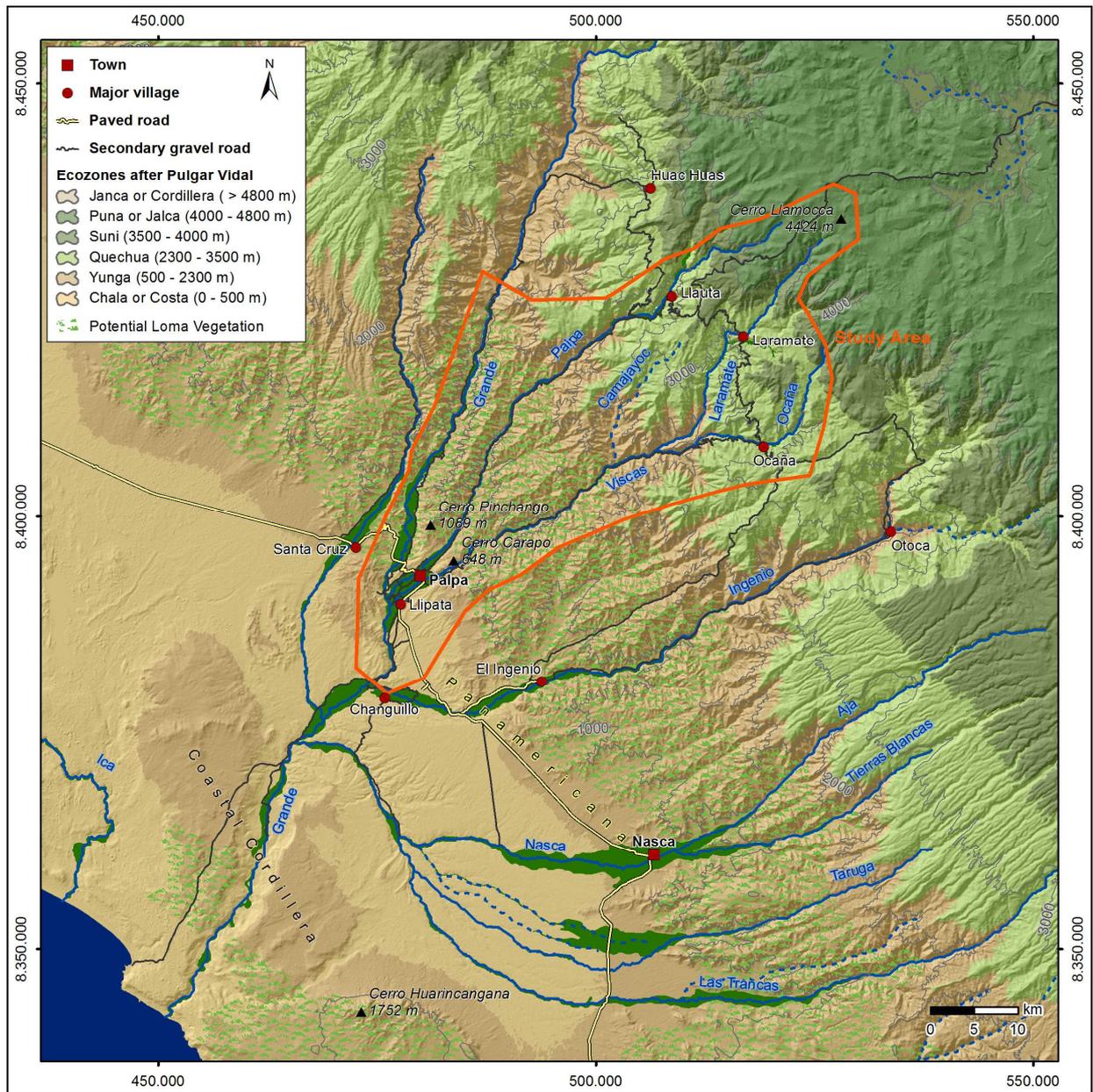
Chapter 5 is dedicated to the acquisition and classification of archaeological settlement data and to the methods deployed in its analysis. Acquisition includes the preparation, revision, and completion of the raw data gathered by the Palpa Project. Classification comprises the definition of settlements and their classification in terms of *chronology* (the periods during which they were occupied), *size* (their relative population size deduced from the extent of dwelling area), and *status* (their likely position in a settlement hierarchy). Raw data and classified data were organized in especially designed databases whose basic structure will also be outlined.

The threefold classification of settlements enables further comparative analyses, namely on dislocation and spatial distribution of settlements, differentiated by settlement size and status classes. Furthermore, the ranges of relative distances from the coast and relative altitude from the valley floor are considered. Finally, methods for assessing the general population development will be discussed. The necessary calculations were carried out with the help of a geographic information system (GIS) and customized database functions programmed in Visual Basic for Applications (VBA). For all considered aspects of settlement pattern analyses, the problem of actual contemporaneity of settlements assigned to the same chronological unit is crucial and will be discussed in detail.

The results of these analyses will be presented in Chapter 6 – *Results: Diachronic Settlement Patterns, 1500 BCE-1532* – along with a presentation of other archaeological data and descriptions of representative or especially important settlements. The chapter is organized by chronological units but starts with two sections on general observations concerning architecture and spatial distribution of certain settlement types.

In Chapter 7, entitled *Discussion: Settlement, Migration, and Climate Change*, is dedicated to the discussion of the major changes in settlement behavior, the degree of probability of a temporal correlation with significant climate fluctuations, and the likelihood of a causal link between these phenomena. The broader cultural and environmental context presented in Chapters 2 and 3 will be taken into account, especially with respect to migration.

Finally, Chapter 8 contains summarizing conclusions about possible linkages between settlement behavior and climatic events as well as an outlook on future research. It is hoped that the results may stimulate future research and encourage comparison with studies addressing similar problems of long-term human-environment relationships on various scales – macro-regional, continental, and global. Some newly or further developed methodological approaches, especially with regard to population development, may also be applicable to other study areas and data sets.



Map 1: The location of the study area in southern Peru. The inlay map at the lower left uses a standard geographic coordinate system while the main map and the inlay map on the lower right are projected to UTM, zone 18 S. Map: VS.

2 Nature

Cultural history cannot be understood without first considering the environmental context in which human groups developed. For this reason, the nature of the Central Andes in general and of the study area in particular deserves some attention. The delimitation of the central section of the Andes is not universally defined and researchers from different disciplines may refer to different criteria (geology, climate, geography, national boundaries, or cultural history). A classical delimitation that widely accepted by archaeologists is given by Wendell Bennett and Junius Bird. For them, the Central Andes comprise “the mountains and the desert coast of Peru and the mountains of Bolivia” (1949:95). When adding the northernmost part of Chile, this largely corresponds to the central and south-central Andean cultural areas proposed by Luis Lumbreras (1981).

The tropical high mountains of the Central Andes offer a large and fascinating range of all kinds of different landscapes and its corresponding flora and fauna. Contrary to what one might imagine when thinking of “tropical,” the Pacific coast of Peru and Northern Chile is not covered by jungle, but in fact forms one of the driest deserts on the planet. It is, however, a rather narrow strip of land, only about 20-70 km wide. Farther to the east, the terrain rapidly ascends to altitudes up to 5000 m.a.s.l. with ice-covered peaks reaching to more than 6000 m.a.s.l. The higher one goes, the more moist it gets and step by step the vegetation, initially dominated by cacti, is complemented with bushes and shrubs before it finally turns into grassland. Precipitation at high altitudes in the highlands of the western cordillera feeds rivers that form their course down to the foothills and across the coastal desert into the Pacific Ocean. In the southern section of the Central Andes, especially around Lake Titicaca on the border between Peru and Bolivia, the Andes widen, and between the two mountain chains of the *Cordillera Occidental* and the *Cordillera Oriental* stretches a vast grass-covered plain: the *altiplano* (Map 1, inlay lower right). Only on the eastern flank of the Andes the landscape becomes “typically tropical” in terms of rich fauna and flora. Moisture in the form of rain and fog is abundant. Descending eastwards, the mountain forest turns into the rain-forest of the Amazonian lowlands.



Figure 1: Contrasting environments. From top to bottom: A river crosses the coastal desert in southern Peru, a snow covered mountain peak in central Peru, the altiplano close to the Titicaca Lake, the cloud forest on the upper Andean east flank in northern Peru, and rainforest in the central Peruvian Amazonian lowlands. Photos: VS.

2.1 The Study Area and Its Natural Resources

The Río Grande de Nasca Basin, in which the study area is located, includes coast, foothills, and the highland areas up to the water divide (Map 1). Although this only comprises the comparatively barren Andean west flank, a number of different ecozones are included, each with its own particular set of resources which successive societies exploited over the millennia. Throughout this study, terrain below approximately 2000 m.a.s.l. will collectively be referred to as *foothills* while higher elevations, forming the headwaters of the rivers, are locally known as *cabezadas*. A more fine-grained landscape classification will be presented in Chapter 2.3.

For their riches in fish, mollusks, seabirds, sea mammals, and also algae, the ocean and the shore are and have always been of great economic importance.³ The special importance of seabirds lies in their abundant excrement, known as *guano*, piling up in their colonies on the small isles off the shore (Cushman 2013). *Guano* is a very effective natural fertilizer and might have been used as such by pre-Hispanic societies (Szpak et al. 2012). The ocean may also have served as transport for goods along the shoreline using *balsa* rafts. During the Late Intermediate period (1000-1450 CE) the Chíncha polity, centered some 150 km to the north of the study area, is known to have been involved in an extended maritime trading network reaching as far north as the equator. From there goods such as the shells of the spondylus oyster (*Spondylus princeps*) and the Eastern Pacific giant conch (*Lobatus galeatus*) were imported (Carter 2011, Murra 1975b, Rostworowski de Diez Canseco 1989 [1977]). It is not known, however, if, when, and to what degree the Río Grande drainage was connected to maritime trade.

Close to the shore, the Río Grande cuts through a 1500 m-high coastal cordillera which plays an important part in the local weather regime by blocking off the fog drifting inland from the sea, especially during austral winter. The ponded moisture has the potential to provoke a lush seasonal vegetation cover at the seaward side of the cordillera, the so called *lomas* vegetation (Whaley 2010). In the early pre-Hispanic era, these *lomas* were probably seasonally grazed by wild guanacos (*Lama guanicoe*), which constituted a welcome prey for human hunters. Even only a few years ago, Víctor Palomino (2006) still observed some wild guanacos grazing at the mouth of the Río Grande de Nazca, but generally, only livestock can be found there today. Besides big game, *lomas* offered further resources that have contributed to the diet of pre-Hispanic inhabitants, including a number of wild edible plants small animals like snails (Engel 1973)⁴ but also soils and temporary water supply for cultivation. Overgrazing as well as logging and charcoal production left many *lomas* devastated, but some decades ago, Javier Pulgar Vidal (1981:43) still listed Ica as a typical *lomas* area, and so did the *Oficina Nacional de Evaluación de Recursos Naturales* (ONERN 1971b).

Between the coastal cordillera and the Andean Mountains stretches a roughly 50 km-wide desertic plain (*pampa*) that has been cut into by the Río Grande and its tributaries and several ancient erosion channels, which have been dry for thousands of years. At the foothills some of the river valleys are up to 2 km in width forming extended floodplains.⁵ Further uphill they narrow down to constricted canyons. The Río Grande itself is the only river of the whole drainage that reliably carries water all year round while all of its tributaries fall dry for several months during the austral winter. The fertile floodplains are almost entirely cleared and irrigated, and formed the backbone of local agriculture for at least the last 3000 years. The discharge volume of the rivers that determines the available amount of irrigation water is extremely variable, however, causing violent floods and heavy erosion of riverine fields in some years and serious water shortages in others. The unpredictability of the water regime turns agricultural enterprises into high-risk speculations. The situation may have been more stable during particular pre-historic periods (see Chapter 2.2.3).

The lower parts of the foothills northeast of Palpa are almost as barren as the coastal desert plain. Only at higher altitudes above 800-1000 m.a.s.l. is there some cactus vegetation present. Bertil

³ Today, algae are used in the production of cosmetics rather than as food.

⁴ On page 275 Engel mentions the consumption of land snails for the case of the *Lomas de Mongoncillo*, south of Casma in the Norte Chico. However, significant quantities of snails can also be found in archaeological domestic layers in the study area, suggesting that they formed part of the diet of the pre-Hispanic inhabitants of the South Coast as well.

⁵ When I use the term "floodplain" as a synonym for the broadest sections of the irrigable valley floors, I do not want to imply that the respective areas are actually frequently flooded under Holocene conditions, although single large-scale flooding events certainly occurred (Mächtle 2007:120-126). But, generally, even in years with extraordinary rainfalls and high river discharge, only relatively small parts of the valley floors are actually flooded and sedimentation can be attributed mainly to irrigation during the last 4000 years (Hesse 2008).

Mächtle (2007:135-147) distinguishes a lower, middle, and upper cactus belt each characterized by the dominance of different species. These belts do not strictly follow contour lines but may deviate from these by several hundred altitudinal meters, according to microclimatic conditions and local soils. Around 2000 m.a.s.l. the precipitation levels in especially wet years may suffice for the cultivation of fodder crops at some favorable places.

It is not necessary to distinguish between the coastal strip, known as *chala* (0-500 m.a.s.l.) and the adjacent foothills, termed *yunga* (500-2300 m.a.s.l.) when regarding the spectrum of cultivable plant species in the Río Grande drainage. In both zones, cultivation is restricted to the valley floors and lower slopes and depends on irrigation. Among the crops with pre-Hispanic roots still grown today are cotton (*Gossypium barbadense*), corn (*Zea mays*), chili pepper (*Capsicum annuum*), tomato (*Lycopersicon esculentum*), sweet pepino (*Solunum moricatum*), avocado (*Persea americana*), and cherimoya (*Annona cherimola*). Many others are of less economic importance today but were apparently cultivated at a significant scale in the pre-Hispanic epochs. This is true for several varieties of beans, such as the lima bean (*Phaseolus lunatus*), common bean (*Phaseolus vulgaris*), and giant bean (*Canavalia plagioperma*), but also for different kinds of squash and gourd like common squash (*Cucurbita maxima*), calabaza (*Cucurbita moschata*), spaghetti squash (*Cucurbita pepo*), and bottle gourd (*Lagenaria siceraria*). Other crops include sweet potato (*Ipomoea batatas*), yuca (*Manihot esculenta*), peanut (*Arachis hipogea*), and achira (*Canna edulis*).⁶ A variety of the opuntia cactus known as tuna (*Opuntia ficus-indica*) has possibly always been cultivated for its edible fruits, but at least since colonial times, is also used for farming the cochineal scale insect (*Dactylopius coccus*), whose females produce the red carminic acid, an important organic dye.⁷ There is some debate whether the coca shrub (*Erythroxylum coca*) may once have been cultivated in the Río Grande drainage (Edwards 2010, Schreiber 2001) as it is known to have been the case at the central Peruvian coast (Rostworowski de Diez Canseco 1989 [1977]/1988), but no evidence has been presented so far to support this hypothesis.

The wild huarango tree (*Prosopis limensis*), which naturally grows in the valley floors, provides husks with a sweet edible pulp, now predominantly used as animal fodder. The tree itself also has important functions as regulator of the microclimate and soil moisture (Beresford-Jones et al. 2009, Beresford-Jones 2011, Whaley et al. 2010, Whaley 2010:14-19). Today, most of the huarango forests have been cut down for charcoal production, timber acquisition, and land clearance. Another important wild tree is the Peruvian peppertree (*Schinus molle*) whose fruits, leaves, and bark are traditionally used in the cure of a number of diseases. The fruits can also be fermented to produce chicha de molle, which seems to have played an important part in social and religious ceremonies, at least for some pre-Hispanic societies (Goldstein & Coleman 2004, Matthies Green & Goldstein 2010), though it is not known if it was consumed in significant quantities by the people inhabiting the Río Grande drainage.

Very important fruit trees introduced during colonial times are orange (*Citrus sinensis*) and mango (*Mangifera indica*). The inhabitants of Palpa proudly speak of their town as “la capital de la naranja” (“the Orange Capital”). The *yunga* sections of the rivers are the natural habitat for a fresh water shrimp known as camarón (*Cryphiops caementarius*), which is highly valued as a delicacy of the local cuisine and has been consumed for thousands of years.

Aside from agriculture, gold mining is an increasingly important economic factor in the area. Although the only big legal mine at Sarmamarca in the Viscas valley closed long ago, mining companies have recently begun new exploration and prospection works some kilometers up the valley. Currently operating mines are small and mostly informal. Some of the old galleries of Sarmamarca are still exploited by some informal miners. Given the currently high world market price for gold the apparently easy money seems to be attractive to many locals but most of them are not fully aware of the enormous risks for their health and for the environment (Figure 2). Mining, on a modest scale, also took place in the pre-Hispanic age and traces of these activities can still be found at many locations (Reindel et al. 2013, Stöllner 2009, Stöllner et al. 2013). Ancient mining, however, did not exclusively seek to extract gold and copper but also mineral dyes used for painting ceramic vessels (Vaughn et al. 2007).

⁶ For archaeological evidence of these species in the Río Grande drainage see Reindel & Isla Cuadrado 2001:312, Reindel & Isla Cuadrado 2009:277, and Silverman & Proulx 2002:52-55. Also see Ugent & Ochoa Neves 2006 for an excellent reference for plant use in modern and pre-Hispanic Peru.

⁷ Although tuna had long been thought to have been introduced in Colonial times, in 1970 Engel reported abundant remains of the fruits in caves in the Chilca valley (Central Coast), dating as early as 8000 BCE (Engel 1970:56). Cochineal farming was certainly practiced in pre-Hispanic Mexico, but if it was also common in precolonial Peru is still being discussed (Donkin 1977).



Figure 2: Gold mining around Palpa. Above: Grinding of ore by human powered luffing mills. Lower left: Small informal mine near La Muña. Lower right: Extraction of the gold by amalgamation with quicksilver. The highly toxic quicksilver will afterwards be evaporated with the help of a Bunsen burner. Workers generally do not wear any protective clothing nor face masks. Photos: VS.

overgrazing, especially by goats, heavy damages by water erosion can be observed at many places (Figure 3).

The most important staple crops grown in the *quechua* today are native and introduced varieties of corn, native potatoes (*Solanum tuberosum*), oca (*Oxalis tuberosa*), and olluco (*Ullucus tuberosus*), as well as the introduced cereals wheat (*Triticum aestivum*), barley (*Hordeum vulgare*), and oat (*Avena sativa*). The latter mainly serves as fodder for livestock as does the extensively planted lucerne (*Medicago sativa*). The *quechua* is also the adequate altitudinal step for the cultivation of native pseudo-cereals from the amaranthaceae family, namely quinoa (*Chenopodium quinoa*) and quiwicha (*Amaranthus caudatus*), but the extent to which these were cultivated in the Río Grande drainage in the pre-Hispanic era is not known. The sanqui cactus (*Corryocactus brevistylus*), which has acid but edible fruits, is widespread in the area. These fruits as well as other parts of the plant are also used in traditional medicine.

The Peruvian whitetailed deer (*Odocoileus virginianus peruvianus*) can still be found in the *quechua*, though it is at risk of extinction due to overhunting. Since its remains are well represented in the archaeological record, it apparently also was a preferred prey for ancient hunters. The *quechua* is furthermore the natural

The principal agricultural area apart from the floodplains at the valley floors lies between 2500-3500 m.a.s.l., which largely corresponds to the ecozone of the *quechua* as defined by Pulgar Vidal (1981). While some fertile loess deposits between 500-2200 m.a.s.l. (Mächtle 2007:87-106) cannot be cultivated due to the lack of water, at higher altitudes, precipitation is sufficiently reliable for rain-dependent farming. Where it is possible, irrigation is nevertheless often applied additionally in order to lengthen the cultivation period. The *quechua* zone is not only characterized by sufficient moisture but also by a normally frost-free growing season and by excellent soils. These soils are mostly andosols which developed from weathering volcanic ashes and rocks mixed with aeolian sediment and which are highly fertile (Mächtle 2007:106-110). Fernando Leceta currently studies these soils in detail at the University of Heidelberg within the scope of his PhD thesis.

Aside from local precipitation, a limiting factor for agriculture is the lack of flat terrain, which was overcome by pre-Hispanic societies with the extensive construction of terraces. Some terraces can still be found at slopes with a steepness of more than 60°. Construction, maintenance, and cultivation of these facilities require a substantial amount of manpower and in most cases neither machines nor draft animals can be deployed. This is why today only the broadest, irrigated, and most easily accessible terraces are still in use while the great majority is subject to rapid decay. As a consequence and in combination with



Figure 3: Erosion gullies cutting through ancient terraces. Only the lowermost terraces which are broad, irrigable, and easily accessible are still under cultivation. Photo: VS.

habitat of the wild montane guinea pig (*Cavia tschudii*) from which the domesticated cuy (*Cavia porcellus*) stems. For thousands of years, cuys have been kept in Andean households as protein-rich food. These rodents normally feed on kitchen garbage such as potato peels and are slaughtered and prepared on special occasions. Cuy remains have been recorded from numerous archaeological sites in waste deposits and as grave offerings.

At higher altitudes, animal husbandry becomes dominant and most grassy areas are used for pasture. Ancient terraces nevertheless hint to the possibility that cultivation at the *suní* step (3500-4000 m.a.s.l.) was widespread in at least some pre-Hispanic phases. Many *quechua* products mentioned above can also be grown here, especially frost-tolerant tubers and pseudo-cereals. Even some patches of the *puna* (above 4000 m.a.s.l.), an area which today is used almost exclusively as a pasture, may have been cultivated in the past. For the present-day local economy, the breeding of cattle, sheep, and goats for milk and meat production in the *suní* and the *puna* is at least equally important as cropping. Domesticated llamas (*Lama glama*) and alpacas (*Vicugna pacos*) providing meat, wool, fertilizer, and transport capacities surely also had some significance in ancient times, but the archaeological evidence does not suggest that herding had a similar importance as elsewhere in the Central Andes, especially compared to the Southern Highlands.

The northeastern limit of the study area is marked by the 4400 m-high Cerro Llamocca, a large black rock dominating the surrounding landscape (Figure 4). Like many prominent Andean mountain peaks it has been associated by local people in pre-Hispanic, colonial, and modern times with a mighty *apu* deity who is believed to have the power to influence weather (Guillén Guillén n.d., Mölders 2010:64-65). In recent years, local communities fenced a wide area around the peak in which they keep a herd of vicuñas (*Vicugna vicugna*). These wild camelids have extremely fine, soft, and highly-valued breast hair that is sheared once a year and sold to manufacturers of exclusive high-quality clothing. Vicuña fibers are used for thousands of years, and the animals surely also provided a source of meat for early hunters as did the bigger guanacos (*Lama guanicoe*). The rabbit-size viscacha (*Lagidium peruanum*) is another potential prey, hunted not only for its meat but also for its fine fur.



Figure 4: The dark rock formation of Cerro Llamocca marks the northeastern limit and the highest point of the study area. Photo: VS.

From the *cabezadas*, the Central and Southern Highlands can be reached relatively comfortably via roads and paths crossing the moderately undulating *puna* and there is plenty of evidence for close social, political, economic, and cultural ties, especially with the Ayacucho region, during large parts of prehistory. During a reconnaissance hike in 2009, I walked along a plastered Inca road south of Huanca Sancos and was shown the ruins of an Inca caravanserai (*tampu*), locally known as Incahuasi, at roughly UTM 563.950 E / 8.452.500 N. Many paths, including the Inca road, had most likely been in use long before the emergence of the Inca Empire.

Only about 50 km northeast of the study area, one of the most important source areas of outcropping obsidian throughout the Central Andes can be found. It includes the sites of Quispisisa (Burger & Glascock 2002) and Jichja Parco (Tripcevich & Contreras 2011/2013). The raw material from this area has been used for thousands of years by people from near and far to produce razor-sharp tools and projectile points.

The vast range of the mentioned resources present in the study area and its surroundings was potentially available to pre-Hispanic people and formed the economic base of cultural development. Since all renewable resources, such as cultivated and foraged plants and the wild and domesticated animals feeding on them, depend on sufficiently high temperature and precipitation levels, any change in climate will alter their availability.

2.2 Climate

Aside from geologic processes, including soil formation, climate is the principal factor in the creation of environments. Climate is typically understood as the average maximum, minimum, and mean values for weather phenomena at a given place or region over a prolonged period of time (at least several decades). Important weather phenomena are temperature, precipitation, humidity, wind strength and direction, and cloud cover (sunshine fraction). Climate refers to the “typical” weather, including variations in the course of a day and of a whole year (seasons) as well as the probability range of deviations from the normal. John Wallace and Peter Hobbs put it this way: “Climate is what you expect; weather is what you get” (2006:5).

Dena Dincauze emphasizes the importance of indicating the spatial unit and the considered time period by stating that “[c]limate, as a statistical generalization about temperature and precipitation, varies from place to place, time to time, and, especially, with the time duration and size of the spatial unit summed. Climatic statements should be understood as statements about the average and range of weather conditions at a place and time of specified scales” (2000:139, emphasis original). For human subsistence and especially for agriculture, temperature and precipitation are by far the most crucial components of climate.

2.2.1 Climate of the Central Andes

In the Central Andes, precipitation generally decreases from east to west (Amazonian rain forest to coastal desert) and from north to south (equator to the tropic of Capricorn). South of the equator, a dry season (during austral winter) contrasts with a wet season (during austral summer), which varies regionally in length and generally falls between November and April (Figure 5). With increasing latitude the wet season gets shorter. At the coast, dense fogs are common between May and November,

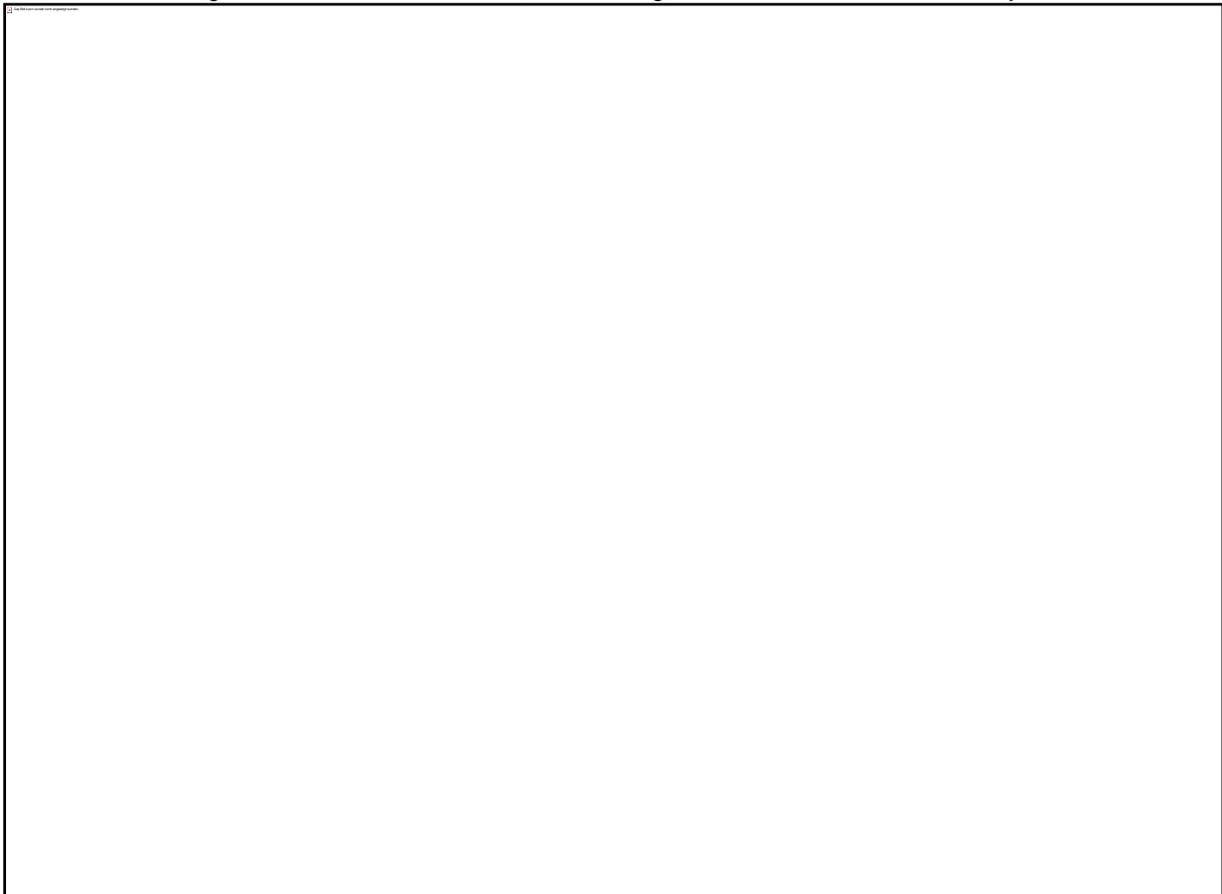


Figure 5: Mean, minimal, and maximal temperatures, and precipitation in the Central Andes in January and July (averages of the years 1950-2000 after Hijmans et al. 2005). The precipitation data is of limited accuracy, uneven quality, and shows interpolation errors, especially in the Amazonian lowlands. The contrast between dry and wet season is nonetheless very clear, as well as the moisture gradient from northeast to southwest. Graphic: VS.

particularly during the morning hours. At comparable altitudes, temperature decreases with distance from the equator and is lower on the Andean west flank than on the east flank. It usually reaches its maximum in January (austral summer) and its minimum in July (austral winter). The temperatures can differ significantly, both diurnally and seasonally, with amplitudes increasing from north to south. Frosts rarely occur at altitudes below 3200 m.a.s.l. (Pulgar Vidal 1981:83). At higher altitudes, they are especially common in, but not limited to, the dry period, and their frequency again increases from north to south (Troll 1931, 1959).

The ocean current known as Peru or Humboldt Current flows from the Antarctic along the Pacific coast towards the equator. The trade winds move the surface water westwards, allowing an upwelling of cold water from the deeps. The cold ocean along the coast cools down the air above it, leading to high air pressure and hence low precipitation – the reason for the aridity of the coastal desert. Only in the north (close to the equator) the lower mountains, the weakening of the Peru Current, the warmth of the equatorial waters, and the heavy precipitations in the Intertropical Convergence Zone (ITCZ) create a completely different climate that allows for lush vegetation at the coast.

In austral summer, when insolation in the Andes is maximal, a seasonally stable high-pressure system forms in the upper troposphere above Bolivia - the Bolivian High. Since all high pressure systems in the southern hemisphere twist counterclockwise (because of the *Coriolis* effect of the Earth's rotation), the Bolivian High moves air along its northern periphery from east to west, i.e., from the moist Amazonian lowlands to the Andean Highlands. Yet, only very few clouds make their way across the whole mountain range. Most release all their moisture in form of precipitation on the way. How much moisture is transported above the Andes depends on the strength of the Bolivian High. In its *center*, where air pressure is highest, however, only small amounts of rainfall can be expected (Garreaud et al. 2009, Mächtle & Eitel 2013). When the Bolivian High is shifted, the distribution of precipitation changes accordingly.

2.2.2 Climate Variability

All factors influencing climate, except mountain altitude, vary on different time scales ranging from seasons to millennia. The strength and position of the ocean currents and of the cyclones and anticyclones fluctuate according to the total energy influx by insolation. A weak Bolivian High causes less air movement and therefore less moisture transport in general. When it shifts southwards, the regions that normally lie just below its center, where almost all precipitation is blocked, then form the northern periphery and therefore receive more moisture transported from the Amazonian lowlands.

Weak anticyclones above the ocean result in weak southeast trades and hence in reduced coastal cold-water upwelling. The equatorial warm water current and the ITCZ shift south and so does the frontier between humid and arid climate at the coast. In extreme cases, the cold water upwelling ceases almost completely, and with the lack of cold but nutrient rich waters, the populations of plankton, shellfish, and all animals feeding on them (fish, seabirds, and sea mammals) break down. This phenomenon, which usually occurs around Christmas time, is known as "El Niño" ("The Boy," referring to infant Jesus).

The air currents (Walker circulation), which very much depend on water surface temperature, also weaken or change their direction. The fluctuation in the extent of air mass exchange is known as the *Southern Oscillation*. Without the cooling effect of the cold-water upwelling, the air off the middle and north Peruvian coast heats up and a low-pressure system develops. This leads to heavy rainfall in normally dry north and central coastal Peru. **El Niño** and **Southern Oscillation** combined are commonly referred to as ENSO. Major ENSO events currently occur every five to seven years, but their frequency and amplitude seems to change within centuries (Caviedes 2001). The underlying mechanisms of ENSO are explained in detail by Kirk Maasch (2008).

The opposite extreme, when the high-pressure systems are developed above average, the trade winds are strong, and the cold-water upwelling is intensified, is known as "La Niña" (Figure 6). The amplitude and frequency of changes in the climate system between the El Niño and La Niña extremes has always been an important factor in human-environment interactions in the Central Andes. At the North and Central Coast, during strong ENSO events harvests are being destroyed, seafood depletes, tropical diseases and pests spread, and catastrophic rains lead to inundations and the destruction of irrigation facilities (Billman & Huckleberry 2008, Caviedes 2001/2006, Rein 2007). On the other hand, some sections of the coastal desert temporarily become grassland, or even form a lake. Farther south,

in the Ica-Nasca region, droughts can be expected due to a weak Bolivian High that has shifted southwards (Mächtle & Eitel 2013). Accordingly, periods with frequent, strong El Niño events are generally less favorable for human subsistence in the Río Grande drainage than times of low climate variability and increased moisture transport across the Andes related to prevailing La Niña conditions.

2.2.3 Past Climate Reconstruction

In terms of human presence in the Americas, the relevant eras of the Earth's history are the last millennia of the Late Pleistocene glacial period⁸ and the following Holocene interglacial (9600 BCE to present). In the northern hemisphere, the time span from the 13th to the 11th millennium BCE is characterized by an alternation of warm and cold phases (interstadials and stadials, respectively) – each lasting only several centuries – with the last stadial of the Pleistocene, the so-called Younger Dryas, spanning the time between 10,900 to 9,600 BCE (Carlson 2010). Since then, the relatively warm global temperatures of the Holocene persist until today. For the southern hemisphere, recent data seems to argue for a more continuous warming trend since 16,000 BCE, interrupted only by the so-called Antarctic Cold Reversal between 14,500 and 12,800 BCE (Blunier et al. 1997). However, smaller-scale climate changes on the global and especially on a regional level occurred also during the Holocene. These surely affected human societies as well (Anderson & Goudie et al. 2007, Cook 2009, Silva Dias et al. 2009).

Past climate variations seem to play an increasingly prominent role in theories about the rise and fall of *ancient* civilizations the more *present-day* societies are becoming sensitive to the consequences of recent global warming. As a consequence, the impact of climatic driving forces on the destinies of pre-Hispanic Central Andean cultures has been discussed intensively during the last decades. Daniel Contreras recently gave an excellent overview over the research on human-environment relationships in the Central Andes, including many studies referring to climate variability (Contreras 2010). Especially ENSO events are much discussed as a potential trigger for catastrophic collapses of coastal societies (Caviedes 2001, Sandweiss & Quilter 2008, Satterlee et al. 2000, Buren 2001). Sometimes, ENSO is believed to have caused heavy, destructive rains and depletion of marine resources even on the south coast of Peru (Grodzicki 1994, Moseley 2008). Prolonged droughts, in turn, are often suspected to have caused famine due to the resultant breakdown of agricultural production (Dillehay et al. 2004, Dillehay & Kolata 2004, Paulsen 1976, Shimada et al. 1991, Williams 2002).

However, two points should always be kept in mind when treating paleo-climatic reconstructions:

- 1) The reconstruction of past climate has to rely on proxies as indicators for changing patterns. In many cases the links between climate forcing and the response of these proxies are complex and include uncertainties on different scales.
- 2) Even if several climate proxies consistently show the same long-term trends at a scale of several centuries (Abbott & Anderson 2009), the respective sampling resolution may be too low to reveal – potentially significant – short-term variability (Grosjean et al. 2003). A severe multi-year drought may also happen in a period of relatively wet conditions, and abnormally cold

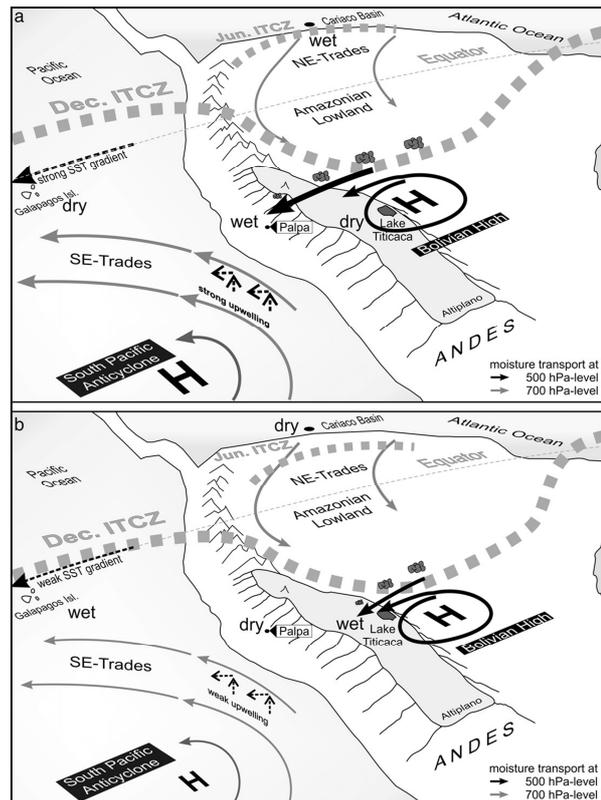


Figure 6: Schematic drawing showing the principal mechanisms which determine climate in the Central Andes. a: La Niña situation with a strong Bolivian High above Lake Titicaca transporting moisture across the Andes. b: El Niño situation with a weak Bolivian High shifted in southeastern direction. Most clouds lose their moisture before reaching the western slope of the Andes. Drawing from Mächtle & Eitel 2013, p. 70.

⁸ The Late Pleistocene or Tarantian lasted from approximately 124,000 – 9,600 BCE.

winters may occur in a generally warm epoch. Reliably pinpointing extreme climate events to time intervals of less than a century is hardly ever possible because very few proxy records from geoarchives offer a sufficiently high resolution combined with a uniformly accurate numeric age control. In effect, if, for instance, important migration movements really do correlate with severe changes in climate or if they actually occurred half a century later or earlier may be hard to determine (Buren 2001).

2.2.3.1. *The Geomorphological Evidence from the Palpa Area*

The climate history of the study area and its surroundings is comparatively well investigated, since research by geographers, geologists, and botanists from the Universities of Heidelberg, Cologne, Kiel, and Jena has been carried out in the region for more than a decade. The research groups studied the geomorphology of the Río Grande de Nasca drainage and the adjacent regions, sampled ancient loess deposits, and took sediment cores from fluvial deposits, irrigated fields, and from the Atocata cushion peatland near Cerro Llamocca, the highest and easternmost point of the study area (Map 3, Eitel et al. 2005, Eitel & Mächtle 2009, Hesse & Baade 2007/2009, Mächtle 2007, Mächtle & Eitel 2009/2013, Mächtle et al. 2006/2010, Schitteck et al. 2012, Unkel & Kadereit et al. 2007). Some of these geoarchives cover the complete time section relevant for the present study (1500 BCE-1532 CE) and most of them at least the last 1000-2000 years. Unfortunately, the current temporal resolution of the sedimentological and geomorphological analyses is not as fine-grained as the archaeological chronology, except for the last centuries before the Spanish Conquest. As a consequence, only general long-term trends can be deduced with some confidence for most of the older phases.

Temperature development has yet not been included in the climate reconstruction developed for the Río Grande drainage. Accordingly, only the general multi-decadal average of precipitation levels and, to a certain degree, the variability of precipitation patterns were reconstructed. These aspects were primarily deduced from the composition of sediments: very small grain size hints to stable conditions with moderate precipitation or regulated irrigation and a vegetation cover slowing down the runoff and minimizing erosion. Layers with big pebbles, in contrast, suggest increased erosion due to largely barren hill slopes and concentrated (though not necessarily frequent) precipitation causing high-energy run-off.

Bertil Mächtle and Bernhard Eitel also draw on archaeological features for their climate reconstruction. This approach is problematic for the present study, which aims at comparing the archaeological evidence on the one hand with the geomorphological evidence on the other. Stratigraphically, archaeological remains can be useful to fix upper or lower temporal boundaries for the formation of certain geological layers. Deducing a change in climate exclusively from the distribution of settlements or the existence of ancient man-made installations interpreted as facilities for water harvesting (Mächtle et al. 2009/2012), however, should be avoided as long as there is no independent evidence from geoarchives. Otherwise there is danger of circular reasoning.

In the following, the current state of paleo-climatic reconstruction, as far as it can be deduced from the geomorphological research alone, will be summarized. Whenever the terms hyper-arid, arid, and semi-arid are used with respect to the study area, they refer to the town of Palpa at the foothills (350 m.a.s.l.) and its immediate surroundings. Precipitation levels are always higher at the *cabezadas* and lower close to the shore.

At the Andean foothills in the vicinity of Palpa, remains of loess deposits can be observed. Loess formation indicates semi-arid (or moister) conditions, because this aeolian sediment can only accumulate where it is fixed by grassland vegetation (Eitel et al. 2005). Grasses, in turn, require regular local precipitation to grow. Based on samples from several loess layers either dated using OSL⁹ or radiocarbon¹⁰, Eitel et al. (2005) and Eitel & Mächtle (2009) assume that sediments accumulated between approximately 9000-2000 BCE. Accordingly, the loess remains in the presently hyper-arid desert point to semi-humid to semi-arid conditions during those millennia.

⁹ Optically Stimulated Luminescence. This method is applicable to minerals in stones or in ceramic sherds for the dating of the last moment these were exposed to fire or sunlight.

¹⁰ The carbon was extracted from snail shells enclosed in the sediments (Mächtle et al. 2010).

Ralph Hesse and Jussi Bade (Hesse & Baade 2007/2009) found layers of fine-grained sediments of up to 6 m in thickness that have been deposited in the valley floors since at least 1500 BCE. These layers are interpreted by Mächtle & Eitel (2013) as an alluvial deposition of eroded loess that was facilitated by a near-absence of vegetation due to more arid conditions. Hesse and Baade themselves, in turn, suggest that these sediments are the result of long-lasting irrigation.

Very early dates for the formation of irrigated anthrosols¹¹ were derived from only a few of the profiles laid out by Hesse and Baade. Arguably, only a few small areas of the valley floor, namely the zone between the Palpa and Viscas rivers southwest of the town of Palpa, were under cultivation during the time section corresponding to the Initial Period in archaeological terms (1500-800 BCE, Hesse 2008). Since then, irrigation was subsequently extended to the point that nearly the entire valley floor was brought under cultivation during the first or second century CE. It has been practiced since this time to present. Hesse assumes that only some minor additional extensions might have taken place during the Late Intermediate Period (1000-1470 CE). This does not exclude interruptions or at least a temporal reduction of irrigation farming. For example, Hesse and Baade state that “profile SF-4 represents several phases of sedimentation since the Middle Horizon (ceramic phase ca. 1300–950 cal BP, 14C age: 1420–1290 cal BP [530-660 CE], Poz-16822), although hiatus are very likely” (2009:125).

At the site of Jauranga, tombs and settlement remains from the Middle Paracas phase (500-380 BCE) until the Middle Nasca phase (tombs only, 300-440 CE) were partly cut into and partly located above the oldest of these fine-grained sediment layers while the youngest sediments covered at least part of the archaeological site (Wetter 2005:21-22).¹² This situation demonstrates that even the oldest of the archaeological features postdate the first deposition of the eroded material, and also that the deposition process continued until at least the 5th century CE. A geological profile off the archaeological site of Jauranga (Pe 306/311) revealed layers of fluvial loam that were interpreted as evidence for phases of increased fluvial activity. Most of these layers date between 1440-1640 CE, except the lowermost, which dates to the 7th-8th century CE (Mächtle 2007, Unkel 2006, Unkel & Kadereit et al. 2007). Geomorphological studies at different levels of ancient river terraces revealed an increased downcutting of the rivers that must have occurred at about the same time. This phenomenon can be attributed to prevailing hyper-arid conditions with occasional heavy precipitation events. The lack of vegetation due to generally insufficient moisture would have facilitated erosion and runoff in case of concentrated rainfall (Eitel et al. 2005, Mächtle 2007, Unkel & Kadereit et al. 2007).

No alluvial sediments have so far been observed which date to the 9th-13th century CE, except fluvial layers in two of Hesse’s profiles (YN-1 and DO) which date to the 11th-13th century CE (Hesse 2008). In turn, all dates for irrigated anthrosols younger than 1000 years fall within the 15th-17th century CE. This finding might indicate general fluvial inactivity and a cessation of irrigation for several centuries. It nevertheless has to be considered that the Spaniards introduced the plow to Peru whereas native farmers traditionally used a digging stick, the *chaquitacla*, which does not turn the soil. Accordingly, LIP sediments may not be preserved undisturbed because the early colonial plow horizon also mixed up the layers immediately below the surface, which are those that had accumulated during the last centuries before the Spanish Conquest.

Mächtle (Mächtle et al. 2009/2012) identified an installation for water harvesting (*khadin*) in a broad *quebrada* next to the large settlement of Huayurí in the Santa Cruz valley, dating to the late 13th century CE. He interprets it as an adaptation to decreasing precipitation rates during a generally moist (near semi-arid) phase. While it has been shown convincingly that these structures were actually used for water harvesting, it may be doubted that they imply less rainfall. As Hesse (2008:78) remarked, the area of this single *khadin* was much too small to suggest that it contributed substantially to the overall agricultural production. People more likely tried to maximize the cultivated area by making use of the non-irrigable *quebrada* floors whenever possible to complement valley floor irrigation agriculture. A second reason for the installation of a *khadin* would be the advantage of having potable water next to the settlement, which was located at some distance from the river. Accordingly, the *khadin* system would still have made perfect sense if local precipitation exceeded the necessary minimum of 100-150 mm per year and if irrigation water was abundant. If water harvesting was an adaptation to drier conditions, similar installations should have been present at all larger contemporaneous settlements located at a comparable altitude. This is not the case, although some *khadin* systems might either not have been identified, yet, or were destroyed in recent times.

¹¹ Irrigated anthrosols are soils that have formed through the sedimentation of material transported by irrigation water.

¹² Note that in the central units (1, 2, and 4) of the site, Isla Cuadrado et al. (2003) found that the uppermost archaeological layers were disturbed by plowing. Wetter (2005) analyzed Test Pit 5, which was located some 30 meters to the east (Figure 63).

Erosional layers containing coarser grains and dating from 1320-1440 CE were found in a *quebrada* debris flow at the site of La Muña (PAP-79) which had destroyed some lateral parts of a long-abandoned Middle Nasca settlement (Unkel et al. 2007:22). This debris flow could only be activated by modest local rainfall in the Palpa area during that time, since the small *quebrada* has no catchment area in the highlands. At La Muña and several other sites, thick layers of very coarse debris, including large pebbles, indicate torrential local rainfall and increased erodibility also during the following centuries. Since erosion must have been favored by the absence of a vegetation cover, this suggests generally arid conditions combined with rare but heavy precipitation events (Mächtle 2007:126-129).

Karsten Schitteck et al. (2012) carried out percussion drilling in the Atocata cushion peatland below Cerro Llamocca. By analyzing the drill cores, they identified major periods of continuous peat formation between 70 and 550 CE, 660 and 1470 CE, and after 1520 CE (Schitteck et al. 2012, fig. 9 on p. 74). They interpret these finds as indicators for stable and regular conditions. Given the altitude of the Atocata peatland (4250 m.a.s.l.), local precipitation has probably always been sufficient on the average, even in dry periods. This means that the more important factor is variability. Uneven distribution of precipitation – prolonged droughts combined with occasional torrential rainfalls – will boost erosion. Such conditions are unfavorable for peat formation while constant and modest precipitation is optimal.

While the stable phase from 70-550 CE supports the conclusions drawn from analyses of sediments around Palpa, the early start of the second stable phase around 660 CE contradicts the observed signals for an increased irregularity of fluvial dynamics in the rivers. According to Mächtle and Eitel, “between 650 and 770 AD [=CE], fluvial downcutting occurred, which is equivalent to increased geomorphological activity. This transition period to more arid conditions was characterized by rare, now flashy river discharge” (2013:66). This instability is not reflected in the Atocata core where peat formation seems to have been steady during that time. The same is true for a “renewed shift to more fragile conditions [...] indicated by a pronounced fluvial activity along all rivers in the Palpa region [...] as well as by local debris flows” (ibid.) beginning after 1440 CE and lasting far into the colonial era. This time span would include the phase of stable peatland formation after 1520 CE. Further analyses, especially of pollen and botanic macro-remains, are in progress and the results will be available soon. They may help to clarify and sharpen the overall picture.

2.2.3.2. The Palpa Data in a Continental Context

Bertil Mächtle and Bernhard Eitel (2013) compared the data from Palpa to several published geoarchives from the Central Andes and the Venezuelan coast in order to check whether they fit into the macroscopic context (Map 2). For the present study, the following archives are relevant because they cover all or at least a significant part of the time span from 1500 BCE-1532 CE (Figure 7):

- 1) A marine sediment core (PL07-56 PC) from the Cariaco Basin, about 100 km east of Caracas (Venezuela) was analyzed particularly for titanium (Ti) but also for iron (Fe) concentrations in order to reconstruct past shifts of the ITCZ (Haug et al. 2001). High Ti values signal heavy terrestrial influx caused by increased river discharge into the basin and hence indicate wetter conditions. Precipitation is highest in the ITCZ which today runs through the Cariaco Basin during boreal summer (June-September). Accordingly, low Ti values indicate a more southerly position of the ITCZ, leading to decreased precipitation and runoff in the region. A southern shift of the ITCZ would also argue for a more southerly and weaker Bolivian High, causing aridity in the study area around Palpa but increased rainfall in the Titicaca and Cusco Regions.
- 2) Another marine sediment core (SO147-106 KL) taken some 70 km off Lima indicates the intensity of erosion and seaward material transport by wind and river discharge as well as the intensity of cold-water upwelling at the central Peruvian coast (Rein 2007, Rein et al. 2005). The analysis concentrated on the flux rates of lithic and biogenic material (especially chlorin) in sediment layers. High chlorin values point to intense upwelling of nutrient rich cold water, which is typical for La Niña conditions. In turn, peaks in lithic input signal an increased discharge of the central coast rivers, especially of the Río Rimac, and hence to increased precipitation over land. Precipitation may increase due to single strong El Niño events causing rainfall at the coast. In these cases, the chlorin flux rate should signal very weak upwelling. In the opposite case of strong La Niña events, lithics flux rates can be expected to be minimal while chlorin production related to intense upwelling is very strong.

At a multi-century scale, however, Rein's curves show a strong positive correlation between chlorin production and lithics flux rates while many peaks, attributable to extreme individual short-term events, correlate negatively as expected. The positive long-term correlation leads Mächtle and Eitel to assume that prevailing La Niña conditions caused increased precipitation (but at the headwaters, not at the coast) because of an intensification of moisture transport from Amazonia across the Andes (Mächtle & Eitel 2013:69-71). The question nevertheless remains as to why some peaks in chlorin production correlate with minima in the lithics flux and hence with apparent droughts. Rein himself proposed a different explanation for the phenomenon:

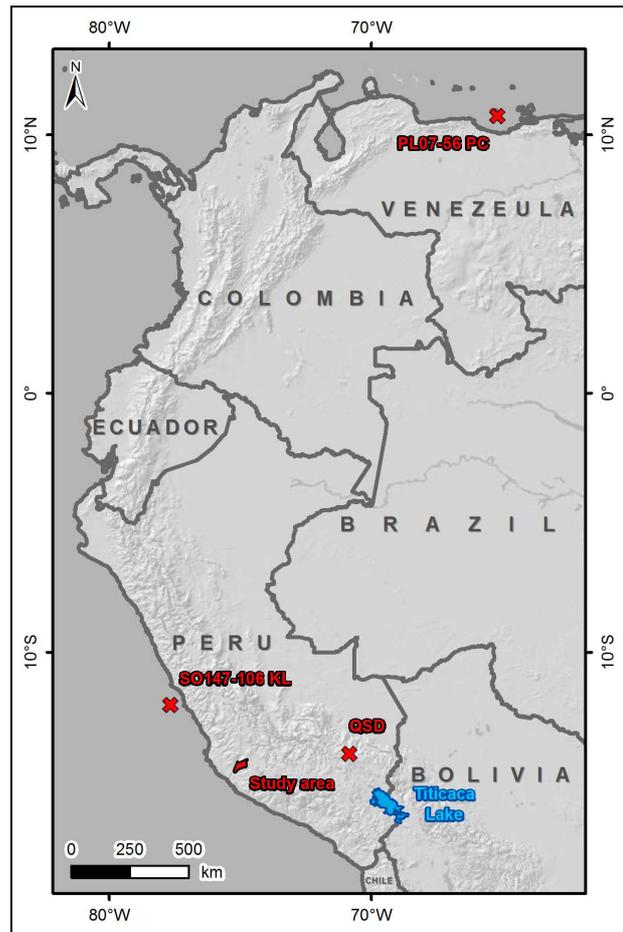
Long-term variability may be due to changes in upwelling intensity or the migration of the upwelling cells but can also be caused by altered boundary conditions. Such conditions could be the chemistry of the upwelled water or the nutrient supply from the continent, but also the preservation of the sediment (oxygen minimum zone, bottom currents, burial rate) on the Peruvian shelf. (2005:7)

Generally, the locally produced chlorin should be regarded as the more reliable proxy because the lithic material was transported by ocean currents over dozens of kilometers and many different parameters can potentially influence its erosion and deposition, e.g., vegetation cover, agricultural activities, and strength and direction of ocean currents.

- 3) A core from the Quelccaya ice cap at the eastern cordillera southeast of Cusco signals precipitation patterns, which were derived from the thickness of annual layers of ice formation (Thompson et al. 1986/1994). Lower layers are more compressed, meaning that the same volume of ice corresponds to a higher volume of water, compared to the upper layers.¹³ Thompson et al. (1984) see a relation between a decrease in precipitation at Quelccaya and El Niño events.

Recently, Thompson et al. (2013) published another article with new complementing data, which was used as a source for the respective curves in Figure 7. The new data from the Quelccaya Summit Dome core (QSD) include ice accumulation, oxygen isotope relation, and nitrate and ammonium concentrations. The latter two proxies reflect precipitation patterns in the southwestern Amazon Basin from which most of the water frozen at Quelccaya originated. High concentrations point to high biological activity, arguably stimulated by abundant rainfall. An increase in precipitation in that part of the Amazon Basin would argue for a southerly position of the ITCZ.

Oxygen isotope relations were used to reconstruct temperature changes. Since cold temperatures reduce the air's capacity to carry water vapor, a relatively higher share will condense at low altitudes. As the heavier ¹⁸O isotope condenses more easily than ¹⁶O, the remaining vapor available for precipitation at higher altitudes (including the Andean mountain peaks) will con-



Map 2: Location of the geoarchives considered for the reconstruction of the paleo-climate of the study area. Map: VS.

¹³ In the supplement material to their 2013 article Thompson et al. present a function to model the non-linear change in ice density depending on stratigraphic position, but they also state that some factors in it are only estimated. Accordingly, the absolute values for precipitation are inexact, especially in case of older phases, but the relative change in precipitation patterns should be reflected reliably.

tain relatively less ^{18}O . Under warmer conditions, the process is the same, but, the air masses will climb higher before the vapor they carry condenses. In consequence, the same mountain peaks will receive precipitation with a comparatively higher share of ^{18}O . Thompson's oxygen isotope record clearly shows the historically well documented "Little Ice Age" (LIA), a colder period between the 16th and 19th century CE (Matthews & Briffa 2005).¹⁴ For the earlier centuries, however, clear long-term trends are hard to recognize in the curve, which rather displays a constant seesaw pattern. Furthermore, temperatures can be influenced by many local factors. Consequently, the Quelccaya record may not reliably reflect broader temperature trends on a trans-regional scale.

- 4) Sediment cores from Lake Titicaca reflect changing lake levels and thereby local precipitation (Abbott et al. 2003, Abbott & Anderson 2009, Rowe & Dunbar 2004). A multi-proxy analysis including lithostratigraphic and macrofossil studies was applied to a drill core transect from shallow to deep water. Although the resolution is too coarse to identify changes on a sub-century scale, general long-term trends are identifiable with some confidence. A lowstand suggests that the center of the Bolivian High was located above the lake, reducing local precipitation but increasing moisture transport to the headwaters of the rivers along the south-central Peruvian coast, including the Río Grande. High lake levels, in turn, argue for a southward shift of the Bolivian High leading to increased rainfall in the Titicaca region but more arid conditions in the study area (Mächtle & Eitel 2013). In general, precipitation patterns should roughly correlate with those in the nearby Cusco region. The layers of the cores were AMS ^{14}C dated, using aquatic gastropod shells. Since these can show old carbon effects (Pigati et al. 2004), Abbott et al. (1997) applied a correction for these effects, but the accuracy of the corrective values is limited. This inaccuracy has to be added to the combined ^{14}C measurement and calibration errors. In consequence, the overall error range of most dates exceeds ± 100 years.

Looking for correlations in the different curves in order to detect major continental-scale changes in climate is tricky for two particular reasons:

- 1) It has always to be taken into account that local factors overlay the general, global driving forces for climate developments and lead to a certain blurring of the picture. Disturbances of the archives caused by processes of erosion and re-deposition may also have occurred. As a consequence, comparisons of absolute values for layers whose times of accumulation are separated by hundreds or even thousands of years are not reliable. Sudden and strong changes, however, can be linked with some confidence to actual climate events.
- 2) Age control is often not accurate enough. Thompson et al. (2013, supplement, p. 1) claim that their Quelccaya core has an annual resolution derived from layer counting from 683 CE on, while the age of older layers had to be interpolated, leading to an error range of up to ± 10 years for the lowermost layer dating to 226 CE. This would be the highest accuracy in age control of all geoarchives. Haug et al. (2001:1304) state that their core from the Cariaco Basin (PL07-56 PC) covers the last 14,000 years, but only ten ^{14}C samples were taken and measured for a temporal calibration. Only three of the derived dates fall within the time frame of interest for the present study. The age of all layers between those that were chosen for direct dating had to be interpolated, assuming a roughly constant sedimentation rate. More dates are available for the core taken off Lima by Rein et al. (SO147-106 KL) but in this case as well, only some chosen layers were dated directly. The date of the accumulation of the material in between these – often representing the record of many centuries – had to be interpolated.

In effect, many prominent peaks in the different curves which seem to point to extreme events, but also the more general long-term trends, may appear to have occurred or started a century later or earlier than they actually did. Errors due to inaccurate interpolation may distort the respective curves for different geoarchives in opposite directions. As a result, the same continental-scale climate phenomenon may have left a strong signal in several geoarchives, but may nevertheless appear as two different events occurring up to 200 years apart.

Many studies on climate influence on pre-Hispanic cultures all over the Central Andes refer directly to the Quelccaya ice core record and the sediment cores from Lake Titicaca when trying to identify extreme climate events, namely ENSO-related major droughts or abnormally heavy rainfalls. This often even happens in cases where the investigated area is located far away from the Cusco-Titicaca

¹⁴ Also see Thompson et al. 1986 for the LIA record in the older cores.

region and may be subject to a different set of factors influencing the local climate. Most authors do not consider the significant regional differences in climate patterns which may be related to each other but often correlate *negatively*. According to the mechanisms explained in Chapters 2.2.1 and 2.2.2, the following relations would be expected between coupled phenomena (Mächtle & Eitel 2013):

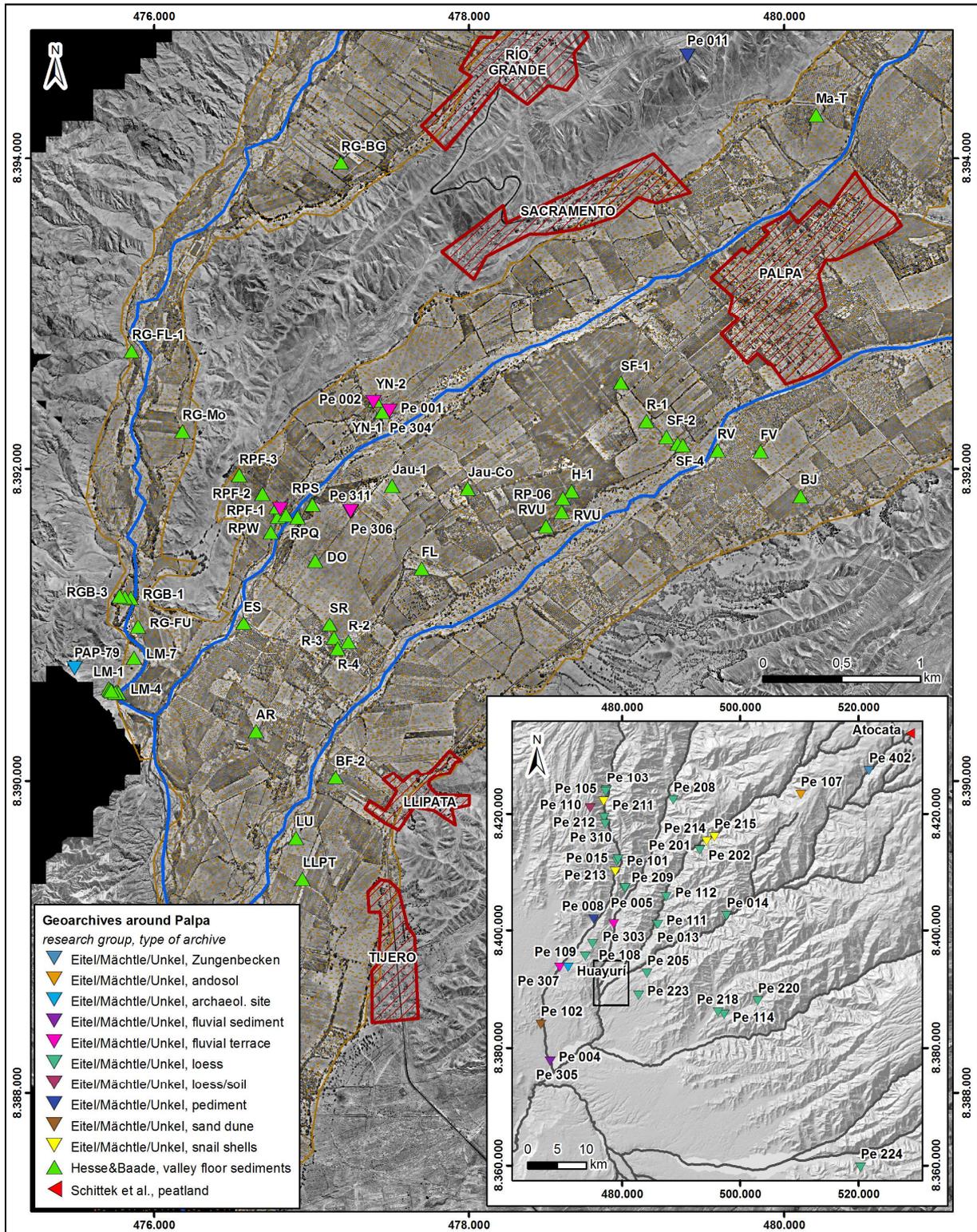
- A northern position of the ITCZ should correlate with strong upwelling, a strong Bolivian High in a northern position, drier conditions in the Titicaca and Cusco regions, and increased precipitation in the headwaters of the Río Grande drainage
- In turn, a southern position of the ITCZ should correlate with weak upwelling, a weak Bolivian High in a southern position, increased precipitation in the Titicaca and Cusco regions, and aridity in the Río Grande drainage

Climate reconstruction for the Río Grande drainage, independent from the interpretation of archaeological features (except for stratigraphic dating), is neither detailed nor free of contradictions. Nevertheless, the following statements can be made with some confidence, if a dating tolerance of about ± 100 years is accepted: (cf. column on the extreme right in Figure 7)¹⁵

- Between 1500 BCE-400 BCE, climate conditions were highly variable. The Cariaco curve signals a relatively southerly average position of the ITCZ before 1000 BCE with a minimum in the 11th century BCE, which should correspond to hyper-aridity around Palpa. Less variable and comparatively moist conditions may have prevailed from the 10th-mid-7th century BCE, aside from a sudden and drastic reversal to dry hyper-aridity around 900 BCE. After 650 BCE and until 450 BCE, the ITCZ as a general trend shifted south, but variability increased again. The increase in chlorin production during the 5th century BCE possibly corresponds to the lowstand at Lake Titicaca during the 4th century BCE, if considering dating uncertainties. Both phenomena would suggest a moister episode in the Palpa area, perhaps during the late 5th century BCE.
- Between 400 BCE-700 CE, climate seems to have been more or less stable with average precipitation levels in the study area. Variability may have increased during the last two centuries BCE. The marked change in the course of the chlorin and lithic curves around 50 CE is not repeated in other archives and might result from local disturbances affecting marine sedimentation off Lima. Rainfall at the headwaters of the Río Grande drainage and the resulting river discharge were probably sufficient to irrigate most of the valley floors at the foothills, although occasional multi-year droughts may have occurred, specifically before 300 CE. Conditions may have been especially favorable between 450-650 CE, except during the early 6th century CE, when upwelling was suddenly reduced, suggesting dryer conditions in the study area. By 700 CE, the chlorin curve but also the titanium content signal a marked climate change which should be related to extreme aridity in the study area. The Palpa records signal fluvial downcutting and loam deposition, suggesting increased erodibility in case of rare but strong rainfalls, due to a lack of protecting vegetation cover.
- From 700 CE-1250 CE, the Río Grande drainage seems to have experienced a period of general aridity. Between 900-1050 CE, however, when the ITCZ shifted back to a northerly position and upwelling increased again, a temporal return to moister conditions should be expected. Interestingly, no local geomorphological evidence reflecting this phase has so far been identified in the study area itself. Possibly, sediments accumulated during this relatively short lapse of time were quickly eroded after 1050 CE when aridity returned, judging from the chlorin and titanium values.
- Between 1250-1440 CE, conditions changed rapidly and dramatically towards a semi-arid climate around Palpa. Local geoarchives suggest regular local precipitation at the foothills, chlorin production off Lima increased, and the titanium content in the Cariaco core suggests a more northerly position of the ITCZ, although the change in absolute values is not very pronounced.
- After 1440 CE until the early Colonial Period (succeeding the Spanish Conquest in 1532) aridity apparently returned. The movement of big pebbles from local sources near Palpa point to

¹⁵ The numeric dates are deduced from the Cariaco, Lima, and Palpa records for which comparatively accurate ¹⁴C dates are available. The Quelccaya curves are, in most cases, too ambiguous to confidently correlate peaks with those observable in the curves derived from other archives.

barren slopes and rare but heavy rains. Upwelling decreased significantly and the titanium values from Cariaco suggest a southern shift of the ITCZ.



Map 3: Location of geoarchives in the Palpa region studied by the research teams from Jena (Hesse 2008, Hesse & Baade 2009), Heidelberg/Kiel (Eitel et al. 2005, Mächtle 2007, Mächtle & Eitel 2013, Unkel et al. 2007), and Cologne (Schittek et al. 2012). Map: VS, orthophoto: ETH Zürich - IGP.

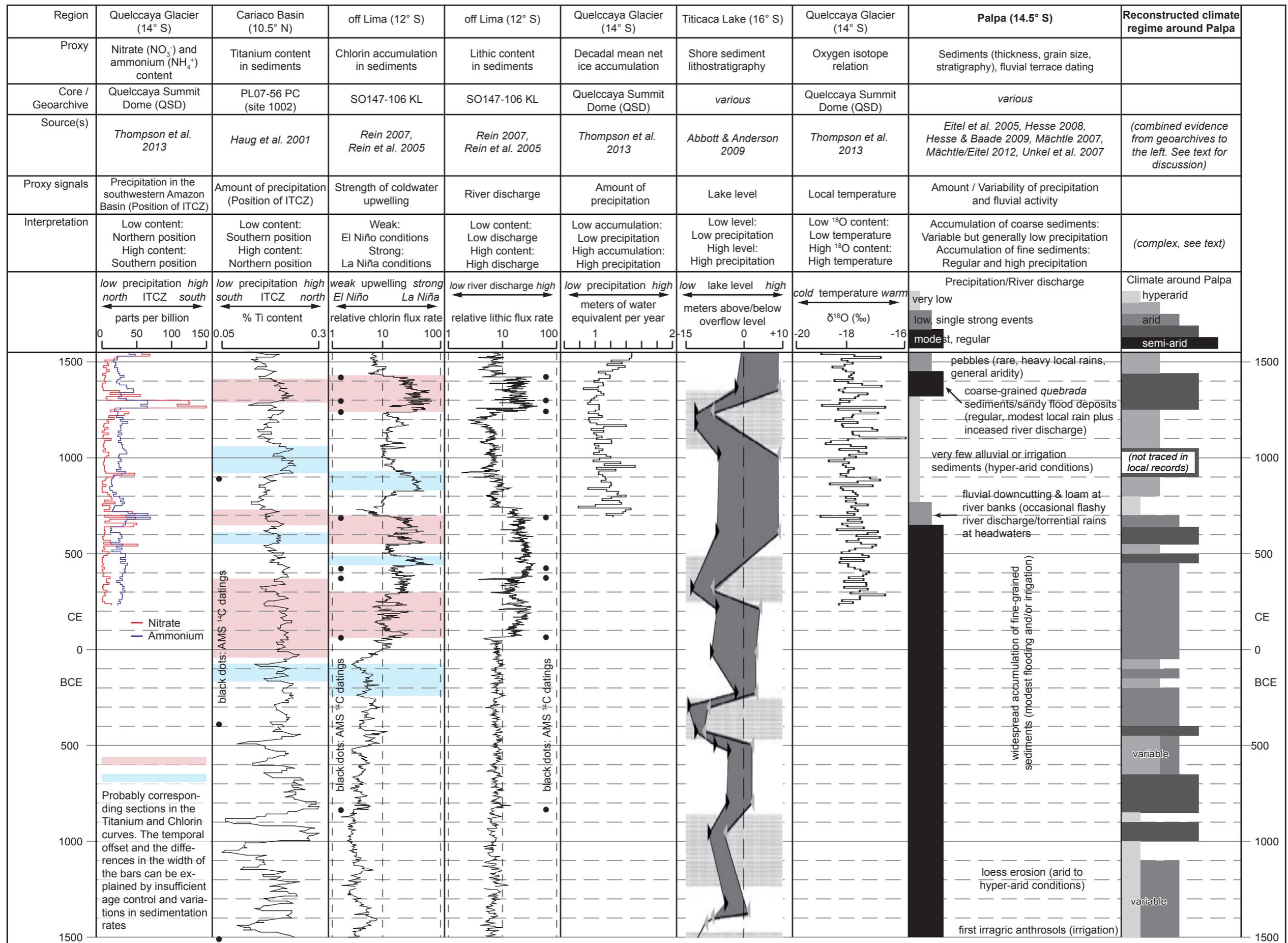


Figure 7: Published geoarchives from the Central Andes and Venezuela, their interpretation as climate proxies, and the deduced climate development in the study area. Graphic: VS.

2.3 Environment Classification

The locally and regionally particular topography and climate of the Central Andes have created a vast range of highly diverse environments to which human societies have successfully adapted for thousands of years. For a better understanding of the conditions in each of these landscapes a specific classification system is desirable. Classification schemes have been proposed by several scholars, drawing on climate, topography, species distribution (especially of plants), agricultural potential, or a combination of these, while others just describe the environment of a certain region but do not attempt to classify the whole landscape.

In 1802 Alexander von Humboldt and his colleague Aimé Bonpland reached Northern Peru on their famous American journey, after having climbed the 6300 meter-high Chimborazo in Ecuador. Some years later, Humboldt (1989) was the first who formulated a systematic *Geography of Plants* in which he describes the distribution of floral species under the changing climatic regimes at specific altitudes, for the equatorial (northern) Andes (between 10° northern and 10° southern latitude). His study does not consider the Central Andes (except the northernmost part), where the situation is quite different. The often cited terms *tierra caliente*, *tierra templada*, and *tierra fría* were only used in later publications and do not refer to the Andes alone (Troll 1959:14).

Half a century later, the Italo-Peruvian geographer Antonio Raimondi (1874-1879) undertook his expeditions through Peru, which formed the basis for his *magnum opus El Perú*. This work was designed to cover all aspects of geography in the broadest sense: geology, meteorology, botany, and zoology, but also history and ethnology. It is more of a descriptive character and does not offer a scheme of environmental classification. It nevertheless inspired the work of the botanist August Weberbauer, who lived and researched in Peru from 1901-1932. In 1911 he published "*Die Pflanzenwelt der peruanischen Anden*" (The World of Plants in the Peruvian Andes) which he dedicated to Raimondi (1976 [1911]). Weberbauer was the first to develop a fine-grained systematic geographic-botanical classification of the Central Andes, based on the distribution of plant species.

Tropical Highlands after Troll

In the late 1920s, Carl Troll (1928/1931/1943/1959) began his studies in the Central Andes and systematically classified and mapped the different environmental zones of the highlands. His three-dimensional landscape classification considered altitude, longitude (east or west of the mountain chain), and latitude. He also pointed to the crucial impact that the diverse landscapes and their respective potentials for agriculture and herding had on the development of "high" cultures.¹⁶

Troll focused on the highlands where he distinguished four types of environments (Map 4a). The *Páramos* refer to humid highlands above the tree line (running roughly between 3200-3700 m.a.s.l.) but below 4000 m.a.s.l. where agriculture is very limited. Higher altitudes belong to the *puna* environment. The *normal puna* cannot be found north of 8° southern latitude but stretches from central Peru to southern Bolivia. From the line Ica-Cusco (14°S) to the south, it is limited to the central and eastern highlands. The *puna* is colder than the *páramo* belt and day-night and summer-winter contrasts increase from northwest to southeast. It is also dryer (semi-humid to semi-arid) and shows marked differences in precipitation between dry and wet periods.

From the line Ica-Cusco (14°S) southwards until the height of Arica (18.5°S), the western cordillera and the western half of the *altiplano* is covered by the *dry puna*, which runs parallelly to the *normal puna* until the border between Bolivia and Argentina (22.5°S), but, contrary to the *normal puna*, it continues farther south as a narrow belt at the east flank. Some *normal puna* isles can nevertheless be found at the west flank between Arequipa (16.5°S) and Iquique (20°S). As the very term suggests, the semi-arid *dry puna* receive much less precipitation than the *normal puna*. Temperatures are lower and the amplitude is greater. Frosts are frequent all year round. The most extreme highland environ-

¹⁶ Many of Troll's ideas about cultural development and the colonialist perspective behind them should nevertheless be seen critically. Troll published a number of studies, books, and articles advocating European colonialism during the 1930s and early 1940s clearly showing his basic attitude towards the matter (e.g., Troll 1936/1937). He also willingly and deliberately collaborated with the Nazi government (Zimmerer 2004).

ment is the arid *salty puna* of southwestern Bolivia, northern Chile, and northwestern Argentina with even more extreme temperatures and less precipitation. The scant surface water converges and then evaporates in extended shallow lakes with no outlets, leaving behind the formerly dissolved salts.

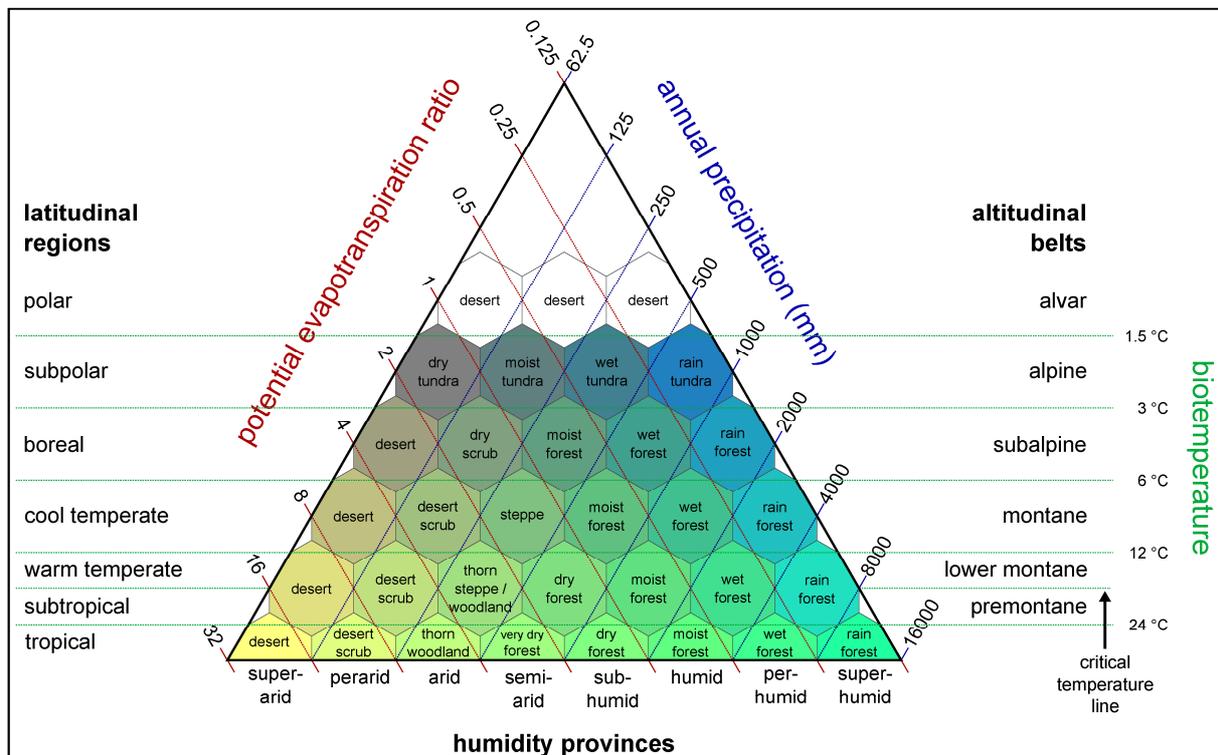
Troll's classification is still the only one considering the Central Andes as a whole from the equatorial latitudes down to central Chile, but it focuses on the highlands above 3500 m.a.s.l. No further subdivision is offered for the lower altitudes at both flanks.

Life Zones after Tosi

In 1960, Joseph Tosi published his first ecological map of Peru, applying the classification scheme of life zones developed by Leslie Holdridge (1947/1967). It was accompanied by a detailed guide explaining his criteria (Tosi 1960a/1960b). A second revised and updated edition was later published by the Peruvian *Oficina Nacional de Recursos Naturales* (ONERN 1976, INRENA 1994).¹⁷

Holdridge's approach was based on accumulated annual precipitation and biotemperature (Figure 8). The latter is calculated as the average annual mean temperature with all measurements below 0°C set to 0°C and those above 30°C set to 30°C. This is because 0-30°C is the temperature range within which plant growth is possible. Temperatures decrease with increased distance from the equator (latitude) and with increased altitude. The lower the temperature, the lower is the evapotranspiration. If precipitation exceeds evapotranspiration, the climate is humid to super-humid; otherwise it falls within the range from sub-humid to super-arid. A cold region with a humid climate may receive the same amount of precipitation as a warm and arid one (e.g., moist forest and thorn woodland in Figure 8 both receive 250-500 mm of annual rainfall). The influence of temperature and precipitation on plant life decreases logarithmically: the warmer and moister, the lesser the impact of an increase by an absolute value of temperature or moisture.

Bio-temperature and annual precipitation similar to those at high altitudes in the tropics can be found close to sea level at high latitudes. Other factors nevertheless vary considerably with latitude, espe-



cially the contrast between seasons. As a consequence, each latitudinal region has its own set of life zones. Accordingly, the plant community of a wet tundra life zone at 4000 m.a.s.l. in the tropics is very different from that of a sea-level wet tundra at a subpolar latitude.

The territory of Peru falls within the tropical, subtropical, and warm temperate latitudinal regions, and due to the height of the Andes almost all altitudinal belts are present. Additionally, precipitation patterns on the east and west flank are very different so that almost all possible life zones can be found inside the borders of Peru (84 out of 103, INRENA 1994:24). The study area and its surroundings fall within the subtropical latitudinal region, except the special case of the coastline and the coastal cordillera which were classified by Tosi and ONERN as “warm temperate.”

The Tosi/ONERN scheme is very fine-grained but of limited use for the reconstruction of past climate conditions, since it requires accurate and continuous meteorological data, which is only available for the past decades. The numerous subdivisions of desert formations are irrelevant for human land use and can be treated here as a single unit. Some of the other life zones may also be lumped together. For the study area and its surroundings the result of this simplification is shown on Map 4b. From the coast to the water divide, several types of deserts (*desierto*) can be found up to about 2000-2500 m.a.s.l. Above, belts of desert scrub (*matorral desértico*) cover the area up to roughly 3000-3200 m.a.s.l. before transitioning into a steppe (*estepa*) environment. Finally, the altitudes above 3800-4000 m.a.s.l. are classified as moist and wet forest (*páramo húmedo/muy húmedo*)¹⁸, and the small patch around and northwest of Cerro Llamocca as wet tundra (*tundra muy húmeda*).

Natural Zones after Pulgar Vidal

A more descriptive and less model-based classification system for all altitudinal zones is offered by the Peruvian geographer Javier Pulgar Vidal (1981). Pulgar Vidal defines altitudinal ranges for eight types of “natural regions” traditionally distinguished by the aboriginal population (Map 4c). This classification has been widely accepted and is often taken as reference, especially in the anthropological literature, but, like Tosi’s, it is limited to the national borders of modern-day Peru. Each natural region is characterized by specific climatic and topographic patterns, forms the habitat of a distinct set of flora and fauna, and offers different potentials for human land use.

In the present study, the terminology of Pulgar Vidal’s concept of natural zones will be used, because it is broad enough to allow interregional comparisons but still detailed enough to consider the differences between altitudinal steps. I will therefore present these zones in more detail. The temperature ranges and values for annual rainfall given by Pulgar Vidal often rely on very scarce data of few meteorological stations and should be complemented with additional measurements. For this purpose, I used the database of the Food and Agriculture Organization of the United Nations (FAO 2001) but imported the relevant information into a new database, which I designed and optimized for a better overview and custom grouping of selected values.¹⁹ The stations with the most complete data, predominantly recorded from the 1930s-1970s, are listed in the catalog “ClimateData_Peru.pdf,” which can be found in the “ClimateData” folder on Supplement DVD 1. In the “ClimateData_Peru_EnviroZones.pdf” file, the data from all station located in the same environment zone were grouped. In the following, indications of temperature ranges and precipitation amounts refer to these (rounded) values.²⁰

- 1) The *chala* or *costa* comprises the coastal desert strip between sea level and 500 altitudinal meters. In normal years, the accumulated annual precipitation in the *chala* comes close to 0 mm and may only locally reach up to 30 mm. Temperature extremes range from 8-32°C and mean temperatures from 13-27°C. The entire Peruvian coast offers abundant marine resources, because the upwelling cold water is extremely rich in plankton, which is the basis for a food chain including fish, sea shells, crustaceans, seabirds, sea lions, and finally humans. Furthermore, some edible algae species known as *cochayuyo* play an important role as iodine

¹⁸ ‘Forest’ is the term used by Holdridge for his global scheme, but in the subtropical Andes, the local term ‘*páramo*’ fits much better because most of this zone lies above the tree line. At lower latitudes, e.g., Central Chile, ‘forest’ is appropriate again.

¹⁹ The FAO-database can be ordered on a CD-Rom (FAO 2001) or downloaded at no cost at <http://freegeographytools.com/2007/fao-world-climate-data>. My own modified version can be found in the “ClimateData” folder on Supplement DVD 1.

²⁰ At many stations, the measurements are discontinuous, scrappy, or not well documented but this is often the only available data for a vast region.

suppliers (Masuda 1985). For agriculture, the irrigated floodplains and deltas of the rivers are most important and generally highly productive.

Pulgar Vidal describes five topographically distinct sections. The study area falls into section 2, which is characterized by the presence of a coastal cordillera with altitudes between 700 and 1500 m.a.s.l. stretching between the Paracas peninsula (14°S) and Acarí (15.5°S) (Mächtle 2007). It blocks most of the coastal fog, so that the weather in Ica and Palpa is sunny at most days of the year while in Lima, for example, the sky between May and November is locally known as *panza de burro* (donkey's belly), referring to the greyish color of the dense fog cover.

Where advanced foothills, the *lomas*, are located close to the coastline, this fog dams up on the seaward side and condenses. This moisture is sufficient to fuel vegetation growth. The lush the plant cover, the more fog can condense in a positive feedback cycle. Consequently, undisturbed *loma* vegetation, including perennial shrub and tree species adapted to survive the fogless season, is rich and manifold.

- 2) The term *yunga* is used for the terrain up to an altitude of 2300 m.a.s.l. On the west flank, it starts where the *chala* ends: at 500 m.a.s.l. (*yunga marítima*). There also exists a *yunga* step on the east flank with the same upper limit but starting only above 1000 m.a.s.l. (*yunga fluvial*). The river valleys of the *yunga* are generally narrow and deeply cut in, leaving little room for river-bank cultivation. The slopes are steep, stony, and often subject to heavy erosion.

The *yunga marítima* lies above the fog level and hence enjoys sunny weather and high temperatures during most of the year. The temperature range is roughly 7-32°C with mean temperatures between 17°C and 25°C. The higher elevations are significantly cooler than the lowermost parts. Precipitation is almost as sparse as in the *chala*.²¹ Accordingly, the environment is desertic, showing only some cactus flora, which becomes increasingly dense with altitude. The data from Copara, Pampa de Majes, and Vitor show values below 20 mm but this should not be regarded as representative for regions farther north or at higher altitudes, where more precipitation can be expected.

In the *yunga fluvial*, the temperature range is roughly the same as in the *yunga marítima* as to judge from the dates of Huánuco in central Peru. It is the only station in the FAO database representing the *yunga fluvial* and thus cannot illustrate north-south contrasts. However, it shows that the *yunga fluvial* is much moister than its western counterpart and less sunny due to seasonal cloud cover (a fact overseen by Pulgar Vidal who, on page 65, mentions Huánuco as a place enjoying an especially high amount of sunshine). Although there is no local data available, this should be especially true for northern Peru, where frequent rain and fog fuel the spread of an impressive cloud forest.

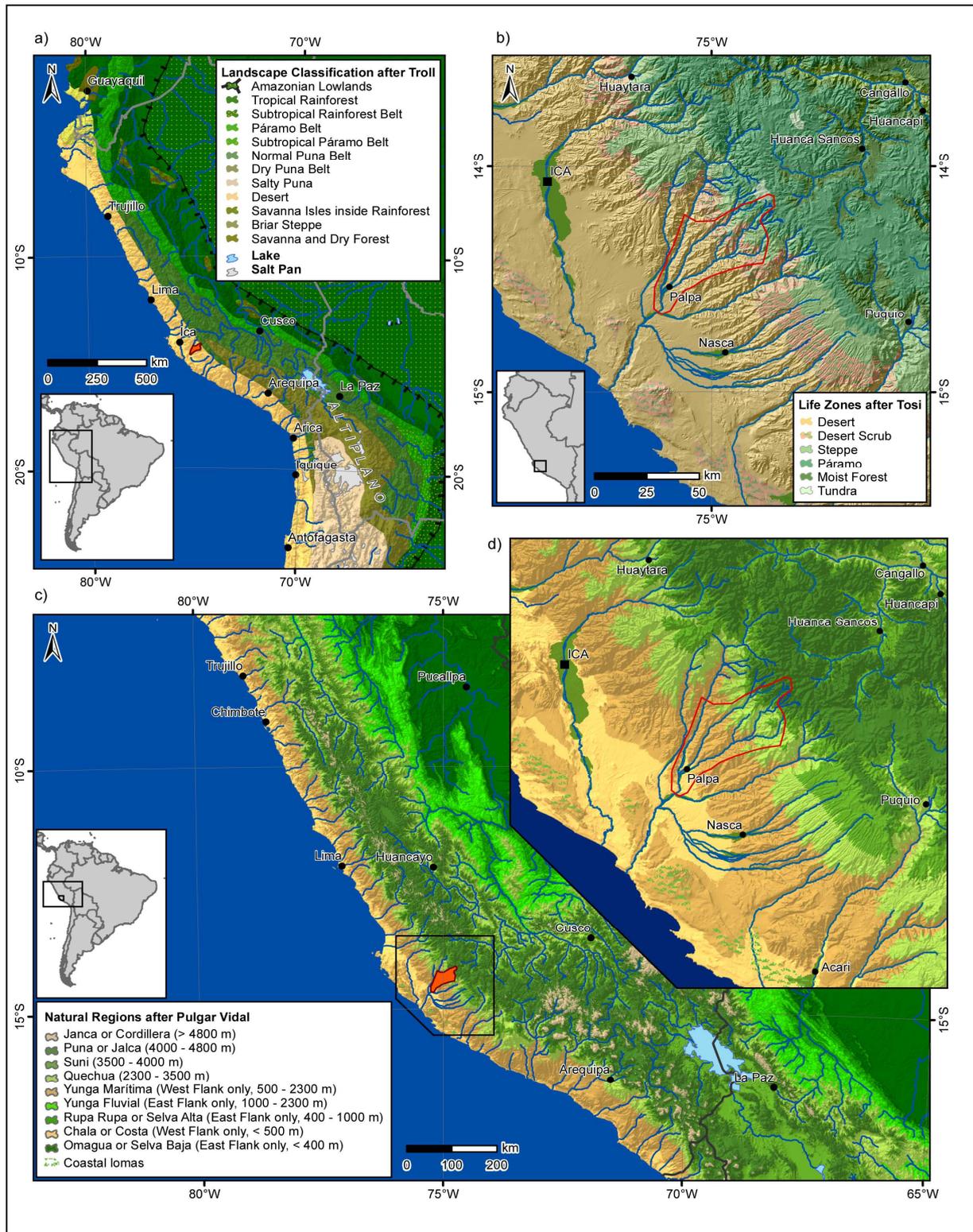
- 3) The altitudinal zone above 2300 m.a.s.l. and up to 3500 m.a.s.l. is the *quechua*. Temperatures are still relatively moderate, but show marked day-night and summer-winter contrasts. The extremes range from 1-28°C, and the mean temperatures from 10-19°C. Nightly frosts may occasionally occur in the upper section during austral winter, but most of the *quechua* is frost free – at least during the growing season. The *quechua* on both flanks of the Andes generally receives enough precipitation for rain-dependent farming (550-750 mm), although, once again, the east flank is moister while on the west flank some lower areas are affected by occasional droughts. Besides the major coastal river deltas, the *quechua* is the most important zone for agriculture and human settlement. In the pre-Hispanic era the scarcity of even terrain was compensated for by large-scale terracing of slopes but during the last centuries many terraces were abandoned.
- 4) From 3500-4000 m.a.s.l. stretches the narrow belt of the *suní*. It comprises the steep slopes, high ridges, and lower mountain peaks above the *quechua* zone. The almost flat *altiplano* around Lake Titicaca and farther southeast with altitudes from 3800-4000 m.a.s.l. also falls into the *suní* class. Temperatures can range from -12 to +19°C but mean temperatures generally shift between 4°C-11°C. Nightly frosts are frequent during the austral winter months but rare during the summer. With an annual precipitation between 575-765 mm, the *suní* can be used for rain-dependent farming of frost tolerant crops like a variety of tubers and the pseudo-cereals quinoa (*Chenopodium quinoa*) and kiwicha (*Amaranthus caudatus*).

²¹ The station at Huancabamba is an exception, because it still falls into the moist equatorial climatic regime.

- 5) The *puna* or *jalca* ranges from 4000-4800 m.a.s.l. and is the most elevated inhabited zone. Most of it is a more or less continuous undulating plain but the slopes of the higher mountain peaks are also included. Although the *puna* is not physically divided into an eastern and a western part it is important to note that in southern Peru, the southwestern part is significantly dryer (Paucarani, 286 mm) than the northeastern one (Cuenca Río Verde, 732 mm), as already discussed by Troll. Precipitation increases farther north (Pacocochoa, 992 mm, Cerro de Pasco, 1052 mm). The temperature range from -12°C to +16°C is almost the same as in the *suní*, but the mean temperatures from -2°C to +7°C are clearly lower. Nightly frosts can occur any day of the year but are obviously more common in winter. The *puna* is mainly used as pasture land, although in the lower areas and in those with a favorable microclimate, some frost tolerant tubers can be cultivated.
- 6) All altitudes above 4800 m.a.s.l. are referred to as *janca* by Pulgar Vidal. This zone comprises the highest mountain peaks, most of which have a permanent cap of snow and ice. No data from stations at that altitude is included in the FAO database but following the temperature gradient, it seems likely that at the lower reaches of the *janca* day temperatures are some degrees above 0°C while at night there is frosting. Precipitation probably follows a similar pattern as in the *puna*: the southwest should be drier than the east and the north. Due to the harsh conditions, only few and scattered vegetation consisting in mosses and lichens is present but no cultivation of any kind is possible nor are there any noteworthy pasture lands. As Pulgar Vidal (1981:156) points out, the importance of the *janca* lies in its water storing and regulating capacities through glacier formation. The glaciers store precipitation during the wetter months in form of ice and release melting water all year round. This reliable water source is also available during the dry period.²²
- 7) On the east flank only, just above the *yunga fluvial*, stretches the *rupa-rupa* or *selva alta* from 400-1000 m.a.s.l. It comprises the eastern foothills and the valleys between them. Precipitation can vary greatly between regions, ranging from only 976 mm/year at Quillabamba to almost 7000 mm/year at Quincemil. Generally, precipitation is especially abundant in austral summer but still significant in winter with increasing seasonality from north to south. Temperatures vary between 16-32°C with mean temperatures from 21-25°C, and there is little difference between summer and winter.
- 8) The Amazonian lowlands are termed *omagua* or *selva baja* by Pulgar Vidal and comprise all areas below 400 m. The *omagua* is covered by rainforest and receives a similar amount of precipitation as does the *rupa-rupa* (1100-3000 mm/year). In the south, the austral summer months are much moister than the winter half-year. The temperature range from 15°C-33°C is almost the same as in the *rupa-rupa*, but the mean temperatures of 22°-27° are slightly higher.

For the study area and its surroundings, only the natural regions *chala*, *yunga marítima*, *quechua*, *suní*, and *puna* are relevant. When comparing maps 4b and 4d, it is clear that Pulgar Vidal's classification comes very close to the simplified version of Tosi's scheme: the *chala* and *yunga* largely correspond to the desert, and the *quechua* to the desert scrub and the moist forest west and east of the water divide, respectively. The *suní* more or less parallels the steppe, and the *puna* the *páramo*. Pulgar Vidal surely knew Tosi's work and even lists it in the reference section of his book, but he does not refer to it in the text itself. It is therefore unclear to what degree Pulgar Vidal draws directly on Tosi but there certainly is some implicit influence. For the reconstruction of past human-environment relationships (see Chapter 4.3) Pulgar Vidal's five-fold distinction based on altitudinal ranges should be sufficiently detailed. From here on I will therefore use his terminology when referring to ecozones in central and southern Peru.

²² Currently, the widespread retreat of glaciers due to global warming causes serious problems in many highland regions. Fields cannot be irrigated sufficiently; people and livestock lack potable water (Fraser 2009, Vergara 2011).



Map 4: Environment classification after Troll (a), Tosi/ONERN (b), and Pulgar Vidal (c,d). Map a) is based on Troll 1931, p.273, but clipped to a section between 0-24° southern latitude. Map b) shows a simplified zonation compared to the second edition of the ecological map (ONERN 1976). Similar life zones were grouped and the color set used here differs from the original. Maps c) and d) are based on an ASTER-DEM classified according to the altitudinal zonation proposed by Pulgar Vidal (Pulgar Vidal 1981, cf. map on p. 12). Map: VS.

3 Culture

Since the first humans reached South America more than 12,000 years ago, the unique environment of the Central Andes has been the habitat for numerous societies, all of which featured their own particular set of subsistence strategies and forms of social organization. The region has thus been the backdrop for a long-term, multifaceted development of culture.

Many cultural activities of economic or social character produce material remains, such as projectile points, ceramic vessels, postholes, figurines, cave paintings, or temples. As Gordon Childe once stated, the study of these remains can help to reconstruct at least some aspects of the culture of past people and to delimit this culture's presence in space and time. Child pointed out that "[w]e find certain types of remains – pots, implements, ornaments, burial rites, house forms – constantly recurring together. Such a complex of regularly associated traits we shall term a 'cultural group' or just a 'culture'" (1929:v-vi). Naturally, a sharp and unambiguous delimitation of cultures is not possible. Such units highly depend on the subjective weighting of cultural markers by the person who defines them.

Most early theorists equated a culture – in an archaeological sense – to an ethnic group or even a race (e.g., Childe 1929:vi, Kossinna 1911). This is problematic because different ethnic groups may share a very similar culture and may therefore belong to the same culture group (cf. Narr 1985). If an ethnic group is understood as a social construct (Barth 1969) it is hardly possible to delimit it on the basis of archaeological remains because there is generally no unambiguous evidence for group identities based on *ideas* of ethnicity (though Sommer (2003) is more optimistic in this respect). The equation with race is obviously inadequate because any kind of culture can potentially be adopted by any human individual, regardless of race. Accordingly, there are many examples of past and present societies acculturating persons or groups of foreign (cultural and genetic) origin, for example Roman Italy, where Latins, Greeks, Etruscans, Celts, and numerous Italic tribes were incorporated into Roman society during the course of the centuries.²³

In short, when referring to the prehistoric past, it seems most appropriate to focus on cultural rather than ethnic groups (Chrisomalis & Trigger 2004). Accordingly, an *archaeological culture* is a culture group of the past which has been (re)constructed on the basis of its material remains. It is commonly defined by the presence of those types of relics (and their specific constellation within the body of material remains) that are regarded as characteristic by the archaeologist. Namely, certain stylistic traits of artifacts and architecture, special burial customs, or a combination of these are usually seen as culture markers. Distribution patterns of such markers help to delimit the habitat of a past culture group and to reconstruct its development through time and space. William Conklin puts it this way:

Pattern analysis is actually a common, though perhaps somewhat unconscious, tool of the analytic archaeologist. Where pattern configurations can be related to earlier or later ones, they are presumed to reveal cultural continuity. Where similar sets are synchronic, cultural coherence is suspected. Analyzing the quality and symbolic meaning of patterning is the proper work of the art historian, but analyzing the societal implications of patterning is indeed the central work of the archaeologist. (1988:147)

It has to be cautioned that even if identical or closely similar cultural markers can be identified at different sites, the people who lived, worked, or otherwise acted at these sites cannot be assumed with certainty to have shared the same culture. Groups of people using the same design for certain artifacts do not necessarily share the same language, values, beliefs, economic strategies, or political organization (cf. Narr 1985).

More concrete information on these aspects may be available where written sources exist which can be deciphered by today's specialized scholars. In South America, however, no such records predate the arrival of the Spaniards. Keeping this in mind, the assumption that the distribution of similar material remains is related to the habitat of a more or less uniform past culture group is only a model whose appropriateness must be tested continuously. Its validity may come into doubt or it may even be completely rejected in light of future studies. Archaeological cultures defined on the basis of the distribution of material remains are analytical units of present-day researchers which are meant to reflect the actual existence and range of a more or less uniform past culture group but may actually fail to do so (cf. Eggert 2012:305-318).

²³ Also see Barth (1969) for a general discussion of ethnicity. Barth explicitly mentions several cases of constant incorporation of outsiders into certain present-day ethnic groups.

3.1 Cultural Macro-Regions of the Central Andes

When discussing external relations between past societies in the study area and neighboring valleys to those of more distant regions, I will frequently refer to broader cultural macro-regions within the Central Andes. Such a spatial division is commonly employed by anthropologists and provides a rough geographic orientation. Since the ranges of specific archaeological cultures overlap and change over time, these macro-regions cannot be delimited sharply on the basis of material remains, especially when regarding time intervals of several millennia. For this reason, scholars draw borders differently, although the core areas are generally agreed on (e.g., Bennett & Bird 1949:95-103, Lanning 1967:30-32, Lumbreras 1972/1981). A distinction is usually made between coast and highlands. The transition between both zones is fluent, but the frontier could be placed between *yunga* and *quechua* at approximately 2300 m.a.s.l. To the east, the beginning of the *rupa rupa* at about 1000 m.a.s.l. delimits the highlands from the tropical rainforest (*selva*). The coast and the highlands can further be subdivided into northern, central, and southern sections. For the *selva*, this is hardly possible because only small sections have been archaeologically explored (Raymond 1988). In accordance with most researchers I would draw the approximate limits of the cultural macro-regions as follows (Map 5):

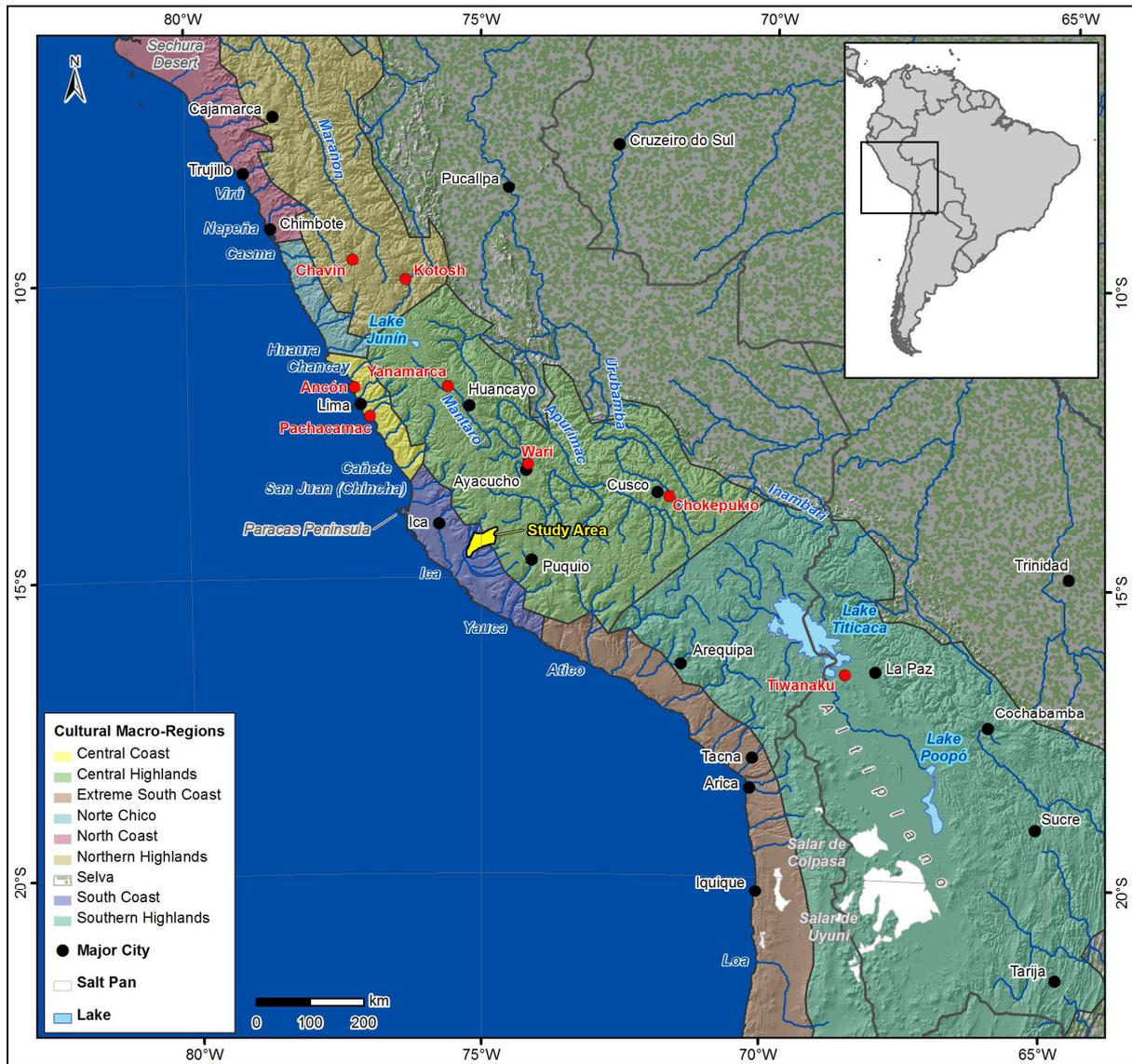
- 1) *North Coast*: the valleys south of the Sechura desert down to the Huaura river.²⁴ The North Coast can further be subdivided into a northern and a southern part with the border running between the Nepeña and Casma valleys. The southern part is known as *Norte Chico*. In the following, the term "North Coast" will therefore be used for the northern section only.
- 2) *Central Coast*: the valleys between the Chancay and Cañete rivers.
- 3) *South Coast*: the valleys between the San Juan (Chincha) and Loa rivers. The South Coast, too, can be subdivided into a northern and a southern part with the former stretching down to the Yauca valley and the latter comprising the much larger section between the Atico and Loa rivers. This southern part, the *Extreme South Coast*, is particularly arid and has comparatively few archaeological remains. Many authors therefore actually refer to the northern section only when speaking of "South Coast". This will also be the case in the following chapters of this study.
- 4) *Northern Highlands*: the gashed mountain sides east and west of the upper Marañon river.
- 5) *Central Highlands*: the relatively flat areas around Lake Junín and the more rugged highlands paralleling the Mantaro and the Apurímac rivers.
- 6) *Southern Highlands*: the relatively flat *altiplano* around Lake Titicaca and farther south, and the mountain chains delimiting it to the east and west.
- 7) *Selva*: the eastern Peruvian and Bolivian lowlands below 1000 m.a.s.l. characterized by dense tropical rainforest.

Again, I want to stress that this is a technical division and should not be confused with actual cultural boundaries. In the following, when referring to cultural macro-regions according to this definition these are spelled with capital letters.

3.2 Previous Research

The impressive ancient monuments of the Central Andes were already of great interest to the Spanish *conquistadores* and the viceregal administration. Unfortunately, this interest was not born out of the desire to study the pre-Hispanic cultures or to preserve their material heritage. In fact, it was the tremendous quantity of gold and silver objects buried in ancient times as grave offerings in the tombs of high-status individuals which attracted the conquerors. Temples and graves were looted by official mining companies on a quasi-industrial scale and tons of fancy items containing precious metal were smelted down into bars for the benefit of the colonial rulers. In the end, these gold and silver bullions also financed the costly European wars of the Spanish kings (cf. Moseley 1992:16, Ramírez 1998: Chapter 5, Zevallos Quiñones 1994).

²⁴ The northernmost extreme of Peru is culturally, climatically, and ecologically related to the equatorial area and is not regarded as part of the Central Andes as defined at the beginning of Chapter 2.



Map 5: Cultural macro-regions of the Central Andes and important archaeological sites mentioned in the text. The study area is located in the transition zone between South Coast and Central Highlands. Map: VS.

Scientific interest in Andean antiquities arose during the 19th century fueled by the journeys of Alexander von Humboldt. Humboldt's habit of documenting all kinds of phenomena made him a pioneer for many scientific disciplines in the Americas. Besides geology, botany, zoology, history and contemporary politics, he also paid close attention to the pre-Hispanic monuments he had the opportunity to visit (Humboldt et al. 2004 [1813]). Other early scholars followed his example. The great merit of their work lay in the detailed drawings, photographs, and descriptions of many monuments that were later destroyed or badly damaged by human or natural impact. Some documented excavations were also carried out, already. Especially important in this respect are the works of Mariano Eduardo de Rivero y Ustáriz and Johann Jakob von Tschudi (Rivero y Ustáriz & Tschudi 1971 [1854]), Ephraim George Squier (Squier 1973 [1877]), and Wilhelm Reiss and Alphons Stübel (Reiss & Stübel 1880-1887, Stübel & Uhle 1892). They were all well aware of the fact that the Inca culture, treated in Spanish chronicles and still extant in the contemporary indigenous population, had predecessors, and that some of the monuments they visited, particularly those at the site of Tiwanaku immediately south of Lake Titicaca, were not erected by the Incas but much earlier. Still they did not know how far back they went in prehistory. This problem could only be addressed by further systematic archaeological studies based on controlled excavation.

3.2.1 The Development of a Chronological Framework

The German scholar Max Uhle is generally referred to as the “father of Andean archaeology.”²⁵ During his fieldwork in Peru between 1896 and 1911, he dug at numerous sites, but concentrated on cemeteries. Uhle’s broad knowledge of so many important sites enabled him to identify superregional stylistic similarities. In this respect, his works at Tiwanaku (Loza & Uhle 2004, Stübel & Uhle 1892), at the Bolivian side of Lake Titicaca (although he was not allowed to dig there) and at Ancón (Kaulicke 1983) and Pachacamac (Uhle 1991 [1903]) north and south of Lima, respectively, were of special significance. They allowed him to distinguish a pre-Inca style that could be identified at all three locations and that was apparently also older than the respective local cultures which were known to have directly preceded the Inca.²⁶ It marked what would later be called the Middle Horizon. At Pachacamac and many other sites he further noted that there were even older layers and tombs that contained artifacts of regionally different styles and at Ancón he identified the, to that day, oldest known remains which he attributed to a “primitive fisherfolk.” With the identification of a pre-Inca cultural horizon separating an early and a late period of regional developments, Uhle laid the basis for the broad pan-Andean chronological framework that was later worked out by Kroeber (1944) and Rowe (1962) and is essentially valid still today.

The second person of outstanding importance in early Andean archaeology was the Peruvian Julio C. Tello who, similar to Uhle, also conducted countless excavations at sites all over Peru between 1919 and 1942 (Dagget 2009). Tello was the first to recognize that Uhle’s “fisherfolk” in fact used stylistic elements similar to those observable in architecture of and artifacts from the impressive ruins of Chavín, Kotosh, and other sites in the northeastern highlands, as well as on the Paracas Peninsula on the South Coast (Tello 1929/1960), thereby identifying a third, early horizon (Kaulicke 2010:93-104).

While temporarily employed by the University of California, Uhle had accumulated a large collection of artifacts, especially pots, which he sent to Berkeley, where the University and its museum are located. This collection stimulated further research at this institution with a special focus on style development. The anthropologist Alfred Louis Kroeber (1930) began to study the Uhle collection in the 1920s and led two archaeological expeditions to Peru in 1925 and 1926. Drawing on the works of Uhle and Tello, he fully established the idea of pan-Andean, or at least pan-Peruvian horizons which he defined as follows: “By horizon style I mean one showing definably distinct features some of which extend over a large area, so that its relation with other, more local styles serve to place these in relative time, according as the relations are of priority, consociation, or subsequence” (1944:108).

In the 1960s, John Rowe, another scholar teaching at Berkeley, proposed a general chronological framework for the Central Andes based on the earlier works of Uhle, Tello, and Kroeber. He named the period of Inca influence the *Late Horizon*, that of Tiwanaku and Wari influence the *Middle Horizon*, and the time when the so-called Chavín style was widespread he called the *Early Horizon*. These horizons were separated by periods of local developments termed the *Early* and the *Late Intermediate Period*. The period before the spread of the Chavín culture is called the *Initial Period* and it starts with the introduction of pottery.²⁷

Rowe’s approach is special not only for its introduction of a systematic nomenclature but also for the fact that his periods, unlike the evolutionary concept of stages, are regarded as strictly chronological units. It should therefore be possible to establish a numerically dated “master sequence” in a chosen region as a fixed standard to which styles from distant areas could be related and thereby dated (Rowe 1962). Rowe chose the Ica valley for this purpose, which lies immediately north of the Río Grande drainage. Both valleys had always been closely related culturally throughout prehistory. Since Uhle, Tello, and Kroeber all had undertaken excavations there, the Ica region at that time was one of the archaeologically best investigated areas in the Central Andes. Rowe studied the pottery collections

²⁵ A good overview of Uhle’s life and work is given by Rowe (Rowe 1954).

²⁶ The quintessence of Uhle’s ideas is best resumed in a manuscript stored in the Ibero-Amerikanisches Institut in Berlin, written in 1918 but only published posthumous in 1959 under the title “Wesen und Ordnung der altperuanischen Kulturen” (Uhle & Kutscher 1959 [1918]).

²⁷ Whether the introduction of pottery is a suitable criterion for the delimitation between Initial Period (or the Formative) and Archaic Period remains under discussion since other major developments regarded as milestones, such as the domestication of plants and animals and the erection of monumental buildings, occurred much earlier (Kaulicke 2010, Lumbreras 2006, Ōnuki 2001). In this study the introduction of pottery is taken as the border stone for technical reasons, because the chronological classification of most sites analyzed heavily depends on surface sherds. Furthermore, the only pre-ceramic site identified so far in the study area and the first sites where pot sherds are present are separated by a 1500-years hiatus.

gathered by Uhle and Kroeber but also undertook further field work in order to document stratigraphic relations between pottery-bearing archaeological contexts. Additionally, he applied the recently established method of ^{14}C -dating (Rowe 1961/1965). His Ica sequence could then serve as a master sequence for most of the Central Andes. Rowe's scheme of horizons and intermediate periods is still widely accepted as a feasible framework for a rough chronological orientation, although his numeric dates have to be adjusted.²⁸

In the 1970s, Luis Lumbreras (1974b) proposed a slightly different chronological framework based on evolutionary stages, although most of his temporal units largely correspond to Rowe's periods. Lumbreras termed the Middle and Late Horizons *Wari Empire* and *Inca Empire*, respectively, while the Early and Late Intermediate Periods correspond to his *Regional Developmental Period* and *Regional States*, respectively. The early part of Andean prehistory is subdivided by Lumbreras into a *Lithic*, an *Archaic*, and a *Formative Period*. The first two periods fill the gap left by Rowe for the earliest millennia of human presence in the Andes while the Formative lumps the Initial Period and the Early Horizon. This is supported by newer research which has shown clearly that the styles attributed to Chavin influences actually had predecessors reaching back many centuries before the emergence of Chavin itself (Kaulicke 2010).

Today, many scholars use a mixture of the chronological schemes of Rowe and Lumbreras, drawing on Rowe for the periods from the Early Intermediate Period onwards and on Lumbreras for all earlier periods. The numeric dating and subdivision of these chronological units, however, remain much debated and there is a general trend towards the establishment of largely independent regional chronologies (e.g., Kaulicke 2010).

3.2.2 The Introduction of Settlement Pattern Studies

Uhle, Tello, Kroeber, and Rowe had all focused their work on burial contexts, refuse middens, and some outstanding monumental architecture. A different approach was chosen by Gordon Willey and his colleagues of the Virú Valley Project which was launched in 1946 (Willey 1953). This project had been designed to study the cultural history of a limited region – the Virú valley at the North Coast – by way of the analysis of settlement patterns and by incorporating researchers of different disciplines in order to get a thorough picture of both cultural remains and the natural environment. Willey defined the term settlement patterns as:

the way in which man disposed himself over the landscape in which he lived. It refers to dwellings, to their arrangement, and to the nature and disposition of other buildings pertaining to community life. These settlements reflect the natural environment, the level of technology on which the builders operated, and various institutions of social interaction and control which the culture maintained. Because settlement patterns are, to a large extent, directly shaped by widely held cultural needs, they offer a strategic starting point for the functional interpretation of archaeological cultures. (Willey 1953:1)

The approach is rooted in ideas and research designs developed during the late 19th and early 20th century in England and North America (Parsons 1972) and was especially inspired by the anthropological works of Julian Steward in the Great Basin (western USA).

As a new method, aerial photographs were extensively used to detect archaeological sites, especially along the valley margins, which are almost completely free of vegetation cover. A local ceramic style chronology was established from excavated contexts with reliable stratigraphies. By reference to this chronology, sites that were not excavated could be assigned to a period through the classification of diagnostic surface sherds.²⁹ By comparing the patterns of contemporaneous sites, further conclusions about the cultural development through time could be drawn. The scale, the degree of incorporation of different scientific disciplines, and the adaptation of newly available technologies (airborne photography) made the Virú Valley Project a milestone in Andean archaeology and regional settlement archaeology in general. Its approach was widely adopted and further developed throughout the world, especially in Mesopotamia (Adams 1965/1981) and Mexico (Sanders et al. 1979).³⁰

²⁸ For a detailed discussion, see Chapter 5.2.2.

²⁹ It is always possible, however, that especially the oldest occupations of a long-used site are not represented adequately in the surface material as Willey himself states in a retrospective (Willey 1999).

³⁰ See Kowalewski 2008 for a recent overview.

In Peru itself, only few archaeological projects which took up Willey's approach dealt with a spatial scale, time depth, or interdisciplinary scope comparable to those of the Virú Valley Project. Most were limited to small valley sections or only considered sites of a certain type, size, or period (cf. Wilson 1988:5). In their 1972 review on Peruvian settlement pattern studies, Moseley and Mackey concluded that "[...] it is apparent that in 20 years' time settlement pattern research in Peru has not moved beyond the original Virú Valley foundations. Willey's work remains the best and most complete of this kind" (1972:79).

Only some years after the publication of the cited article, two major projects were launched which can be compared to Willey's work in Virú:

- 1) Jeffrey Parsons, Charles Hastings, and Ramiro Matos Mendieta surveyed the upper Mantaro and Tarma drainages (Central Highlands) in 1975/76 and published their data together with a detailed analysis in 2000.
- 2) David Wilson worked in the lower Santa valley (North Coast) in 1979/80, presenting his results in 1988.

Thereafter and until present, the Palpa Project (since 1997) is the only one which can compare to the Virú Valley Project and even goes beyond it in terms of the extension of the study area, time depth of registered sites, and the scale of interdisciplinary cooperation (Reindel & Wagner 2009).

3.2.3 Settlement Archaeology in the Río Grande Drainage

In the Nasca drainage, as in the Central Andes in general, archaeological interest in ordinary settlements is a relatively recent phenomenon that evolved during the last decades. Most early scholars concentrated on the excavation of tombs and large temples or stylistic studies of pottery and textiles. Most research activity has been concentrated on the Nasca culture and, to a much lesser degree, on the Paracas and Wari cultures. Earlier and later phases received very little attention.³¹

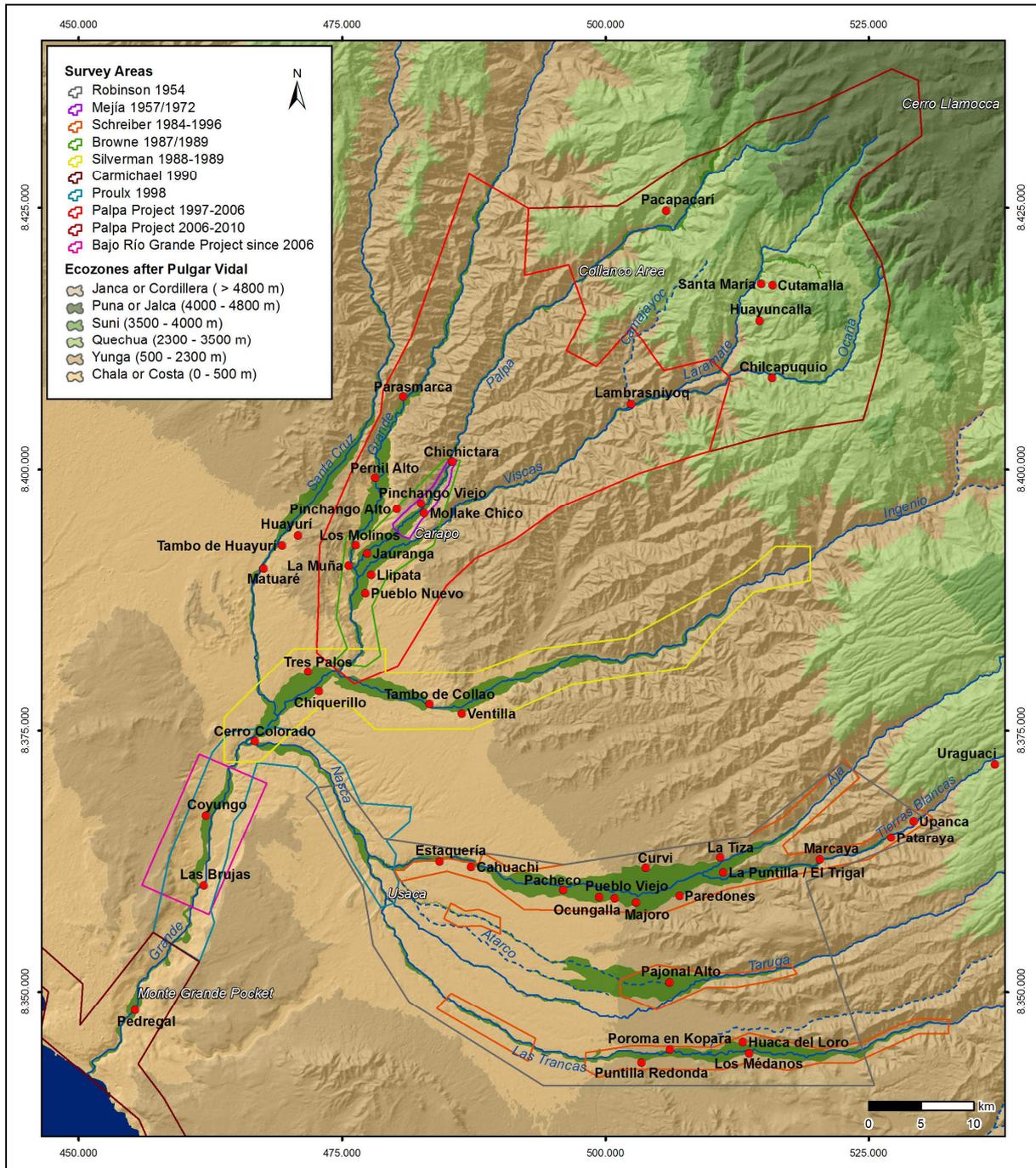
Largely drawn from his excavations of cemeteries in the Chincha and Ica valleys in 1900-1901 (Uhle 1913/1965 [1924-1927]) and from additional vessel purchase, Max Uhle's collection at Berkeley comprises hundreds of polychrome fineware pottery. Pieces attributable to the Nasca culture are particularly well represented. This collection, partly shown in museum exhibitions, boosted public and scientific interest in South Coast antiquities. Before he could extend his activities to the Nasca drainage, Uhle had to travel to San Francisco to hand over his newly gathered pieces to his employer and *Mæcenas* during these years, Mrs. Hearst (Rowe 1954:8). He apparently had another opportunity in 1905 to undertake some explorations in the area and to buy more vessels from looters (Menzel 1977:54, Uhle 1914:8).

In 1922, William Farabee, curator of the Museum of the University of Pennsylvania, undertook an expedition through south and central Peru, including the Nasca region. He visited the large Late Intermediate Period town of Huayurí in the Santa Cruz valley and excavated several Nasca tombs around the great Early Nasca center of Cahuachi. Especially interesting are his photographs of the predominantly Late Nasca center of Estaquería with its somewhat mysterious lines of wooden posts many of which were "[...] dug up and used at wine supports" around 1960 (Kosok 1965:55). As stated by locals, most of the remainder was chopped down in the 1980s or 1990s - to produce charcoal.³² Farabee died in 1925 before he could publish the results of his journey but his successor in office, John Alden Mason wrote a posthumous illustrated report based on Farabee's diaries and field notes (1926).

Julio Tello (Tello 1959:45-47) worked in the area in 1915 excavating numerous tombs in the Nasca valley but he did not describe settlements. Between 1925 and 1929 he directed an expedition of the Museo de Arqueología Peruana in Lima to the South Coast (Tello & Mejía Xesspe 1967). Most of the field work in the Nasca drainage was done by the team members Toribio Mejía Xesspe and Antonio Hurtado (Novoa Bellota 2002). At the same time and in close cooperation with Tello, Alfred Kroeber headed another South Coast expedition sent out by the Chicago Field Museum of Natural History

³¹ For the location of places and sites mentioned in this sub-chapter refer to Map 6.

³² Also see Kroeber 1944:26-27. The posts may once have supported roofs of superficial funeral structures: cf. Tello's and Mejías Cementerio E de La Marcha in the Las Trancas valley (Novoa Bellota 2002:181-188, particularly the drawing on page 183).



Map 6: Location of sites mentioned in the text and areas in which archaeological surface prospection has been carried out by different scholars. Map: VS.

(Kroeber et al. 1998). After a short reconnaissance in 1925, the main campaign in the Nasca drainage took place in 1926 while Tello's team worked in the same area slightly later in 1926/27. Although both groups concentrated on cemeteries again, this time the original documentation also comprises some short descriptions and sketch plans of important settlement remains at sites from different epochs, such as Ocungalla, Majoro, Curvi, Cahuachi, Estaquería (Kroeber's team), Poroma, Pacheco, Pueblo Viejo, and Huayurí (Tello's team).

The Pacheco site deserves a word because it became famous for a large Wari offering deposit where tons of Wari fineware vessels were intentionally broken, probably during some kind of ritual (Menzel 1964:23-28, Tello 1959:49-50). Additionally, there had been several cemeteries around containing tombs from the Early Intermediate Period, the Middle Horizon, and the Late Intermediate Period (LIP) as well as a LIP settlement (Novoa Bellota 2002:200-207). In 1930 Ronald Olson, curator of the American Museum of Natural History undertook an expedition to Peru (Olson 1931). He also worked in

the Nasca valley and especially at Pacheco where he excavated small rectangular subterranean structures containing more oversized Wari vessels that were broken up. Unfortunately, the results of his research have never been published in detail and are only briefly mentioned by Menzel (1964:24-25), Paulsen (1983:103, figure 1b), and Schreiber (1988), who apparently had access to his field notes. The site was largely destroyed by 1950 but Schreiber assumes that a Wari administrative center may once have existed here (Schreiber 2001:436-437). There nevertheless is no clear evidence for this assumption. The surface architecture was originally explicitly reported by Mejía as being “Chincha,” and thus dating to the LIP and not to the Middle Horizon. Dorothy Menzel and John Rowe visited what remained of the site in 1958 when “[...] sherds and structural remains were still to be found scattered over an area of about 300 by 300 meters” (Menzel 1964:23, Rowe 1963:15).

In 1932 Heinrich Ubbelohde-Doering undertook an expedition to the Río Grande drainage. After working in the Santa Cruz valley he went on to Cahuachi where he excavated further tombs. In total, about 50 graves were examined but his published observations on settlements are limited to brief descriptions of the two large LIP towns of Huayurí and Matuaré in the Santa Cruz valley and a mention of a Middle Horizon site somewhere in the Atarco *quebrada* in the SGD (Ubbelohde-Doering 1936/1958).³³ Ubbelohde’s field notes concerning his works in the Santa Cruz valley were later critically revised, complemented by additional fieldwork, and published in detail by Angelika Neudecker (Neudecker 1979).

In 1952/53 William Duncan Strong, who had participated in the Virú Valley Project some years before, led an expedition sent out by Columbia University to document settlements in the Ica valley and the Nasca drainage. These works included limited excavations at chosen sites. Strong was the first to do so in this area as “no stratigraphic or settlement-pattern studies whatsoever had been accomplished in the region prior to 1952” (Strong 1957:1). In total, 81 sites were registered, though Strong himself indicates that “this does not purport to be a thorough survey. There are many more sites in the area than are listed here” (1957:3). Of particular importance are Strong’s excavations at Cahuachi, the largest and most important site of the Nasca culture, which he believed to have functioned as “the main capital site of the Nazca civilization in the time of its own peculiar highest florescence” (ibid.:32). He also visited Estaquería and Huaca del Loro. Unfortunately, this brief preliminary report is the only available publication about the expedition.³⁴

In the following year, 1954, the University of California launched an expedition headed by John Rowe (1956) to the South Coast and the Cusco region. The main goal was to further develop a chronological scheme for the various pottery styles identified in several collections housed in North American museums. In addition to this, several important sites were recorded, surveyed, and test pitted, especially in the Acarí and Ica valleys. In the Nasca drainage, the team member David Robinson (1957) surveyed the southern branches and registered 111 sites, most of which he classified as “cemeteries.” His catalog offers brief site descriptions, but his main concern was about the distribution of ceramic styles and no analysis of settlement patterns is offered.

In 1957 and 1972 Toribio Mejía Xesspe (1972/1976), who had worked with Tello for many years, performed a limited reconnaissance in the Palpa valley, mainly along an 8 km section north of the town of Palpa between Chichictara and Carapo with some excursions to places elsewhere in the region. He briefly described 27 sites from different periods but his analysis focused on stratigraphic relations of Paracas and Nasca pot sherds drawn from test pits dug into a few domestic occupations.

Through the 1950s to the 1980s, the Swiss scholar Frédéric Engel identified, mapped, and described numerous sites in Peru in general and on the South Coast in particular. Especially important are his works about Archaic and Initial Period sites (1966a/1963) and the Paracas culture (1966b/1991). Engel also marked and briefly described sites registered by him and others in an archaeological atlas and catalog (Engel 1980/1981). Although he provides valuable photos and sketch plans of sites and objects, in most cases the information given is sparse and confusing. His limited descriptions of settlements at the mouth of the Río Grande and in the Monte Grande valley pocket (about 8 km inland) nevertheless are of some interest for the present study (Engel 1981:60).

Since 1983, the *Centro Italiano Studi e Ricerche Archeologiche Precolombiane*³⁵ is conducting a long-term project in the SGD directed by Giuseppe Orefici. Excavations were undertaken at several sites

³³ The latter was completely destroyed between 1938 and 1954 (Ubbelohde-Doering 1974) and cannot be located precisely.

³⁴ Helaine Silverman, who had access to Strong’s field notes, published some resuming information and drawings in her 1993 volume (pages 43-54). A complete edited version of the original documents would be of great value to future Nasca research.

³⁵ Italian Center for the Study and Research on Pre-Colombian Archaeology.

with the main focus on the important Nasca centers Pueblo Viejo³⁶ and Cahuachi (Isla Cuadrado et al. 1984) between 1983 and 1988. Since 1989, works concentrate on Cahuachi alone (Orefici 2012:64-71).³⁷ Additional excavations at the same site were carried out in 1984/85 by Helaine Silverman (1993) in preparation of her PhD thesis. Silverman concluded that Cahuachi had only a small permanent occupation but that pilgrims came here for ritual feasts.³⁸

The excavations by Orefici and Silverman were the first sizeable undertakings in a settlement site in the Nasca drainage since Strong's works in 1952. However, Silverman stated in 1993 that "[p]ublications by the Italian project are few and extremely preliminary" and that "Orefici's colleagues await publication of architectural plans and a comprehensive site report on the stratigraphy and associated remains" (1993:28). Although since the release of her book, several publications by Orefici and his team have appeared (Orefici 2012, Orefici & Drusini 2003, Orefici et al. 2009), these in first place present nice pictures of findings but little if any systematic information about their context. A detailed, readable site plan is still missing.³⁹ Given the unique importance of the site, a comprehensive publication of the archaeological data remains a pressing need.

Since the 1980s, several survey projects were launched in different valleys of the Nasca drainage. Katharina Schreiber and a team of students from the University of California in cooperation with Peruvian colleagues undertook intense and systematic surveys in most of the SGD in several campaigns between 1984 and 1996, registering more than 600 sites (Schreiber 1999/2001, Schreiber & Lancho Rojas 1995/2003). Unfortunately, the publication and analysis of this data is limited to a few pages of very general comments on settlement patterns during the Nasca and Wari phases and some coarse distribution maps in the cited works. For this reason, comparability between settlements in the NGD and the SGD is very restricted (cf. discussion in Soßna 2012:224-226). Most of Schreiber's data remains unpublished though some of her students worked with it.

In 1988/89 Helaine Silverman surveyed the Ingenio valley in order to support her theory about the status of Cahuachi with data on settlement patterns (Silverman 2002). Her study is the only one concerning settlements in the Río Grande drainage that has been published in detail, though it is limited to some 350 sites with Paracas or Nasca occupations. MH and LIP sites are mentioned briefly and in general in Silverman & Proulx 2002 (Chapter 11) but were not analyzed.

About the same time, in 1987 and 1989, David Browne and José Baraybar undertook reconnaissance in the Palpa area between the junction of the Río Grande and Ingenio valleys and Chichictara, including both margins of the great floodplain but not the Viscas valley northeast of Carapo. Their survey area hence extended to that of Mejía to the south. Though the two published reports (Browne & Baraybar 1988, Browne 1992) are only preliminary, they include relatively detailed distribution maps and a catalog of 239 sites of all periods, including coordinates. In an unpublished manuscript, Browne describes perhaps the most important Early Nasca center in the region, Llipata, in detail, including a good site plan (Browne n.d.). As the site is successively being destroyed by the extension of the modern village of Llipata, this document may be of special value for future research.

In 1990, Patrick Carmichael surveyed the lowermost section of the Río Grande river and the coastline between San Juan Bay (halfway between the outfalls of the Grande and Acarí rivers) and Independence Bay (south of the Paracas peninsula). He registered a total of 64 sites, most of which correspond to small shell middens, isolated dwellings, or small cemeteries. Especially interesting for the present study are his site descriptions for the Monte Grande oasis in the lowermost section of the Río Grande river about 8 km inland from the shore where also Engel had worked. Carmichael documented several settlements, augmenting the information given by Engel. This includes the large Nasca center of Pedregal, which was also briefly visited by members of the Palpa Project. Unfortunately, Carmichael's 1991 report has never been published officially.

Donald Proulx closed the remaining survey gap between the lowermost section of the Río Grande valley and the confluence of the Nasca river with the Usaca *quebrada* in 1998. His preliminary report,

³⁶ Kroeber named the same site Agua Santa (Kroeber et al. 1998:265).

³⁷ Apart from one campaign dedicated to excavations at Estaquería.

³⁸ This theory has since been questioned as there is, in fact, plenty of evidence for domestic activities at Cahuachi. See Vaughn 2009:163-172 for a critical discussion of Silverman's argument.

³⁹ Three scanned black and white plans are offered in Orefici 2012 on pages 150, 402, and 420, which give at least an idea on where Orefici had worked but for an understanding about the arrangement of structures, Silverman's (1993) maps are much better.

last updated in 2007, is available online as an illustrated PDF document including maps and a catalog of 128 sites of all periods with coordinates (Proulx 2007).

The most extended surveys were carried out by the Palpa Project between 1997 and 2010 (Isla Cuadrado 2010, Isla Cuadrado & Reindel 2005, Reindel 2009, Reindel et al. 1999, 2001). The study area was widened several times until it stretched from the junction of the Grande and Ingenio rivers up to the water divide around Cerro Llamocca in the *puna* at 4424 m.a.s.l. This includes the complete Palpa and Viscas valleys and the Río Grande valley up to an altitude of about 1100 m.a.s.l. as well as the adjacent mountains and ridges. In total, 1155 sites from all periods were registered. Additionally, major excavations took place at several settlements, especially at Pernil Alto (Archaic/Initial Period, Reindel & Isla Cuadrado 2009), Jauranga (Middle-Late Paracas, Isla Cuadrado et al. 2003), Cutamalla (Late Paracas/Initial Nasca, Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013), Los Molinos (Early Nasca) and La Muña (Middle Nasca) (Reindel & Isla Cuadrado 2001), Parasmarcha (Late Nasca, Reindel 2009:455-456, Tomasto Cagigao et al. 2009), and Huayuncalla (Paracas/Nasca/Wari, Castro de La Mata Guerra García et al. 2012). Minor excavations were realized at numerous additional sites.

Christina Conlee, a student of Katharina Schreiber, had worked with LIP settlements in the SGD in her MA thesis (Conlee 1996). For her PhD project she chose the MH/LIP site of Pajonal Alto for excavation and did a detailed analysis (Conlee 2000/2003/2005/2006/2010), which still is the only published in-depth study of an LIP settlement in the entire Río Grande drainage. Conlee has been working at the La Tiza site near the Aja/Tierras Blancas junction since 2004 (Conlee et al. 2009, Conlee 2011). At La Tiza, she found evidence for important settlements of different phases between the late Early Horizon and the LIP. She also claims that an archaic occupation dating around 3600 may have existed here.

In 1997/98 Kevin Vaughn, another student of Schreiber's, excavated the Early Nasca village of Marcaya in the Middle Tierras Blancas valley at about 1000 m.a.s.l. in preparation of his PhD thesis (Vaughn 2000/2009). His study is the first one about the Nasca culture that focuses on domestic activities and subsistence of ordinary people rather than on temples, tombs, and the fancy objects of social elites. Marcaya differed from contemporary settlements in the NGD in that it consisted of circular and oval stone structures rather than angular wattle-and-daub huts. It thus represents an architectural pattern that is more reminiscent of Middle-Late Paracas or Middle Nasca highland sites in the study area of the Palpa Project than of typical Early Nasca foothill settlements. Vaughn and his colleagues continued their research with test excavations at further sites dating to the same epoch, especially at Upanca (Vaughn & Linares Grados 2006). On the webpage of the *Proyecto Nasca Temprano* (Vaughn n.d.) they mention additional places, but no publication about the work carried out there is available, yet.

Hendrik van Gijseghem, also a student of Schreiber's with access to her unpublished field data, and Carlos de la Torre Cevallos undertook excavations in the Paracas/Initial Nasca habitation site of La Puntilla at the confluence of the Aja and Tierras Blancas rivers (Torre Cevallos & Gijseghem 2005, Gijseghem 2004/2006). These excavations were continued until 2010 by the La Puntilla Project, which also included the neighboring contemporaneous site of El Trigal where evidence of fortifications and sling stone deposits were found (Castro-Martínez et al. 2008/2009/2009). Another recent excavation in a settlement in the Río Grande drainage was conducted by Schreiber's student Matthew Edwards at the Middle Horizon site of Pataraya in the upper Tierras Blancas valley (Edwards 2010). This site is the only one in the whole SGD known so far where rectangular architecture has been found which can be attributed to the Wari culture without doubt. It may have functioned as a small administrative center.

Since 2006, the Proyecto Bajo Río Grande directed by Burkhard Vogt from the German Archaeological Institute is undertaking a site survey in the upper section of the lower Río Grande river, south of its confluence with the Nasca river (Vogt 2010). According to the preliminary results, settlement density seems to have been highest during the Early Horizon and the LIP. A special focus has been put on the documentation of aceramic sites. A major excavation took place at Las Brujas below a natural rock shelter, which revealed traces of manufacturing and domestic activities dating to almost all pre-Hispanic periods. The so far oldest layers date back to the 4th century BCE, though still older remains may be discovered during the next campaigns (B. Vogt, personal communication). Also within the scope of this project, Peter Kaulicke investigated looted Early Paracas tombs at Coyungo (Kaulicke et al. 2009).

3.2.4 Archaeological Cultures of the South Coast and the Adjacent Highlands

In this subchapter I will give a brief overview of important archaeological cultures that thrived on the South Coast and in the adjacent highlands. This is essential because cultural development in the study area will not be understood in isolation. People in the NGD maintained close economic, social, and cultural ties to contemporary groups from near and far. Furthermore, migration to and from neighboring regions is an important factor to be considered when analyzing population development and cultural influence. The location of sites and places mentioned in the text is shown on Map 5, Map 6, and Map 7.

3.2.4.1. *The Initial Period (IP) and the Early Horizon (EH) Paracas Culture*

During the Initial Period (1500 BCE – 800 BCE), tendencies toward increased social complexity developed in many parts of the Central Andes (Kaulicke 1994/2008). Although the introduction of pottery was taken as the marker for the start of this period by Rowe (1962), the use of ceramics as such does not constitute a crucial turning point in cultural development (Lumbreras 2008:113). In fact, the transition between the Late Archaic and the Initial Period was fluent. Pottery was probably introduced either from Ecuador or from the Amazonian lowlands where it had already been in use for hundreds or even thousands of years (Roosevelt 1999). Its spread from the north to the south of the Central Andes took several centuries. It probably arrived on the South Coast around 1500 BCE.⁴⁰ Although hunting and fishing remained important agriculture and herding became the prime subsistence strategies during the IP.

On the South Coast, only a few sites related to the Initial Period have so far been investigated (García Soto & Pinilla Blenke 1995, Silverman 1996). Disco Verde next to the Paracas peninsula (Engel 1966a/1991:120-126), Hacha in the Acarí valley (Riddell & Valdez Cárdenas 1987/88, Robinson 1994, Rowe 1963), and Pernil Alto close to Palpa (Reindel & Isla Cuadrado 2009) can be considered the best known examples for that time. Typical features of ceramic vessels found there are ring bases, angular bowls, and bottles with two short spouts, a waisted body, and a centrally placed top handle (cf. Engel 1966a, fig. 41 B, Reindel & Isla Cuadrado 2009, fig. 17, and Robinson 1994, fig. 14-17).

None of the mentioned sites shows monumental architecture comparable to those known from the North Coast and the Northern and Central Highlands and there is no obvious evidence of pronounced social stratification or complexity. Villages were probably sovereign communities connected economically by exchange relations and perhaps also through intermarriage. At the inland sites of Hacha and Pernil Alto, domestic structures are angular and agglutinated. Walls are 30-50 cm thick and made of compacted clay. Vegetal remains and tools for plant processing, particularly grinding stones, leave no doubt that the principal subsistence strategy of the inhabitants was agriculture, though hunting and foraging were still important (Reindel & Isla Cuadrado 2009:277). In turn, the coastal settlements reported by Engel, including Disco Verde, seem to have relied primarily on seafood (cf. García Soto & Pinilla Blenke 1995:47). Virtually nothing is known about the Initial Period in the *cabezadas*, except Engel's brief note on Ramiro Matos' find of some ceramic sherds of the Disco Verde type in the *cabezadas* of Pisco (Engel 1987:90).⁴¹

About the burial customs of the epoch, just as little is known as about settlements. Robinson briefly describes two burials from Hacha, one of a man "interred in a loosely flexed position lying on his back and facing upwards" and another of a woman "placed in roughly the same manner [...] but in a more loosely flexed position," both originally covered by some kind of poorly preserved textile (1994:14-15). The male individual had been given some grave offerings including a necklace, pigments, and an obsidian point. Most interesting is the discovery of a deposit of three adult crania. This could be the earliest evidence known so far for the practice of ritual taking, treatment, and deposition of human heads, which are commonly referred to as "trophy heads." Trophy heads are frequently found in contexts from all later periods in much of the Central Andes (Verano 2008).

⁴⁰ Rowe originally proposed a date of 1930-2000 BCE for its first occurrence in the Ica valley, the place of reference for his chronology, based on a single ¹⁴C sample from the site of Erizo. The reliability of this date is questionable when regarding the general inconsistencies in Rowe's numeric dates (Rowe 1965, also see Chapter 5.2.2.2). New data from Pernil Alto near Palpa suggest a date around 1500 BCE (Reindel & Isla Cuadrado 2009).

⁴¹ No citation is given. Possibly, Engel refers to personal communication.

Around 800 BCE, stylistic influences from the north, commonly known as “Chavín style” mark the beginning of the Early Horizon. Contrary to Tello’s (1960) theory, many typical design traits of the Early Horizon styles did not develop initially in the highlands but were adopted there from North Coast people (Cupisnique style) and then locally modified (Bischof 1994/2013). Still, the site of Chavín de Huantar seems to have played a major role in the later spread of the “chavinoid” art style, iconographic program, and the concepts behind it, which were supposedly of religious character.⁴² Between 800–200 BCE, “chavinoid” stylistic and iconographic influences were widespread among cultures throughout the Central Andes, a fact that justifies the term Early Horizon for this period.

On the South Coast, the local Early Horizon culture is known as the Paracas culture. It was originally defined by Tello based on his excavations in ancient cemeteries on the peninsula of the same name located south of the Pisco delta (Tello et al. 2005 [1959], Tello & Mejía Xesspe 1979). Tello distinguished two types of tombs which he attributed to two phases: Cavernas and Necrópolis. These are now seen as representing only the last phases of a long-lasting tradition and the transition into the Nasca culture. Although ceramics, textiles, and, to a lesser degree, architectonic features of the earlier phases of the Paracas culture show a strong Cupisnique/Chavín influence, it clearly developed out of local Initial Period predecessors and many sites, including Disco Verde, Hacha, and Pernil Alto, were continuously occupied in both phases.

Other simple early-middle Paracas villages, mostly showing remains of agglutinated rectangular structures built of unfired mud bricks (*adobe*), wattle-and-daub (*quincha*), or unworked stones with mud mortar, were partly excavated or at least test pitted at Puerto Nuevo, just east of the Paracas peninsula (Engel 1991:64-65, García Soto 2009), at PV62D13 in the lower Ica valley (DeLeonardis 2000/2005), and at Mollake Chico (Mejía Xesspe 1972:82-83), north of Palpa. At the Karwas site (also spelled Carhua(s) or Carhuaz) south of the Paracas peninsula, where a number of fine Chavín style textiles were excavated from tombs (Wallace 1991), another early Paracas settlement might have existed below the younger structures mentioned by Engel (1981:28-29) and Tello & Mejía (1979:92, also cf. Massey 1986:281-282). The slightly later first occupation at Jauranga near Palpa was also a simple village (Isla Cuadrado et al. 2003, Isla Cuadrado & Reindel 2007, Reindel & Isla Cuadrado 2004). In turn, at the site of Cerillos in the upper Ica valley, a more sophisticated structure with different levels connected via stairways was found which is thought to be a temple (Wallace 1962, Splitstoser et al. 2009). Cerillos may mark the beginning of a development towards a more pronounced social complexity.

During the later phases, the Chavín/Cupisnique influence decreased and some further important developments occurred: In the Ica and Río Grande drainages and apparently also in Pisco and Chincha, the number of settlements increased dramatically and some reached considerable sizes.⁴³ Many were located in defensive positions on hilltops and some were walled. In the northern valleys of the South Coast (Chincha to Ica), new ceremonial and political centers with monumental *adobe* architecture emerged, namely at Animas Bajas and Animas Altas in the Ica valley (Massey 1986/1991) and a number of complexes and *huacas* in Chincha, including San Pablo, Soto, Huaca Alvarado, and La Cumbe (Canziani Amico 2009:-158-165). Chongos was an important settlement in the Pisco valley (Peters 1987-88). On the Paracas peninsula, Wari Kayan was an extended town as were Chuchio and Karwas at the coast farther south (Engel 1980:28-29, García Soto 2010, Tello 1959, Tello & Mejía Xesspe 1979). In these areas, a high degree of socio-political complexity can be assumed, but so far there is no evidence for a formal multi-valley political entity. From the Río Grande drainage, neither extraordinarily extended settlements nor monumental architecture are known.⁴⁴ At the *cabezadas*, sites were documented which show a markedly different architectural pattern of round stone structures, but are associated with the same Paracas-style fine ware known from the coast, though in much lower quantities. Research about these highlanders is still at its beginning and will be treated in more detail in Chapter 6.4.

The burial customs of the people associated with the Paracas culture are diverse, but it is obvious that there were notable differences in the elaboration of tombs and the quantity and quality of grave goods, suggesting a pronounced social hierarchy in the Paracas societies. Some early interments from

⁴² See Burger (1992), though the character of the phenomenon is under discussion and Burger’s chronological placement has to be dismissed completely in the light of newer research (Bischof 2000, Kaulicke 2010, Rick et al. 2009).

⁴³ For the Pisco and Chincha valleys, cf. Canziani Amico 2009:155-175 and Wallace 1971/1972, for the Ica valley, cf. Cook 1999, Massey 1986/1991, and Menzel 1971, and for the Grande drainage cf. Isla Cuadrado & Reindel 2007 and Silverman 1994.

⁴⁴ Cf. Silverman 1996:131 (note that she calls the local Paracas style variant “Tajo”).

Mollake (Mejía Xesspe 1972) and Pernil Alto (Isla Cuadrado 2009, Reindel & Isla Cuadrado 2006) follow the pattern known from Hacha: a single extended body with slightly flexed legs, wrapped in cloths and placed in a simple pit with no, or relatively few, simple grave goods. Only one grave in Pernil Alto contained two skeletons.

In other cases, funeral chambers in more simple or more elaborate variants were documented, namely at Coyungo (Kaulicke et al. 2009) and Mollake Chico (Isla Cuadrado 2009, Reindel & Isla Cuadrado 2006). These contained the remains of up to 23 individuals each. Those from Mollake were obviously not in their anatomic position and seem to have been re-deposited in a process of secondary treatment. Mejía (1972) reports other cases of simple graves with incomplete or dismembered bodies and no offerings from the same area. In Coyungo, the case is not clear, due to disturbance of the site by looting.

Early Paracas textiles from the Karwas site are known to originate from looted tombs (Wallace 1991) which probably contained mummy bundles. At least Tello and Mejía (1979:92) mention that they found such bundles in a cemetery at the site during a brief reconnaissance before the looting, though they compare them to those found at Wari Kayan which date to a late phase.⁴⁵ Such Paracas mummy bundles usually consist of a body in a flexed seated position wrapped in numerous layers of textiles, eventually with smaller adornment and other objects placed in between. It is possible that this kind of body treatment is limited to the regions north of Ica, though Kaulicke et al. (2009) think that the Coyungo tombs might also have contained mummy bundles.

Two simple burials in a seated flexed position were excavated at Pinchango Viejo, near Palpa (Reindel & Isla Cuadrado 1998:54-62), but of particular interest are the Middle and Late Paracas graves from Jauranga. While most earlier burial contexts maintained the pattern of extended dorsal position with flexed legs wrapped in cloths, in a number of later contexts the bodies were “placed in a seated posture within simple pits, legs flexed to the chest and arms folded to the chest or around the legs” (Isla Cuadrado 2009:127). Especially children were also often put in large jars serving as funerary urns. Special cases are the three large chambers with multiple burials showing traces of intentional burning at Jauranga. In sum, the later Paracas phase apparently saw the introduction of new burial customs, including multiple burials and the placement of the body in a seated flexed position.

One further cultural innovation should be mentioned: the transition from petroglyphs to geoglyphs. On the South Coast, petroglyphs can be observed at many sites, including Chichictara near Palpa (Fux et al. 2009, Mejía Xesspe 1972/1976, Nieves 2007). They are difficult to date directly, but judging from iconographic parallels, most seem have been carved during the Paracas, Nasca, and Wari Periods. Some may be older and originate from the Initial Period, however, though this is speculative for now. Towards the end of the Paracas Period, the first geoglyphs were constructed on the hill slopes around Palpa by clearing away the dark oxidized surface stones revealing the bright subsurface sand (Lambert 2006). They show the same iconographic program as many petroglyphs, especially anthropomorphic beings with ray heads. Accordingly, the first geoglyphs apparently constituted a new medium for the expression of traditional ideas.

3.2.4.2. The Nasca Culture of the Early Intermediate Period (EIP)

The Early Intermediate Period (250 BCE – 650 CE) was a time of regionally distinct cultural developments during which the quality of already well-advanced handicrafts like pottery, textile production, and metal working reached a climax in many Central Andean regions. Social complexity and differentiation grew considerably, and in many societies formal ruling elites emerged who controlled extended territories and tens of thousands of subjects.

On the South Coast, the current state of research seems to support the model of a coexistence of at least two cultural traditions during the first centuries of the IEP: Nasca in the Ica and Río Grande drainages (Proulx 2008, Silverman & Proulx 2002) and Topará in the northern valleys (Peters 1997, Silverman 1991, Tinteroff Gil 2008, Wallace 1986). Both show strong continuities with the latest phases of the Paracas culture. With the abandonment of Animas Altas and other sites, the Ica valley apparently lost importance while at the same time Cahuachi in the Nasca valley gradually developed into the prime center as indicated by the beginning of the construction of the first great temple mounds and platforms (Orefici 1989, Silverman 1993, Strong 1957). In the Nasca drainage there were numer-

⁴⁵ Also see the survey report by Alana Cordy-Collins in Carmichael 1991:28-38.

ous further settlements of this phase, some of which were of considerable size (up to 20 ha) but none showed complex monumental architecture (Silverman 2002, Soßna 2012). They rather mostly consisted of simple habitation terraces with *quincha* structures and eventually some small-scale *adobe* or field stone architecture. For Ica, Rowe mentions a “great habitation site” at Cordero Alto, but no further information is given (1963:11).

In turn, the principal settlements associated with the Topará tradition were built more solidly and seem to have had a planned layout. They usually consist of agglutinated rectangular units of stone and *adobe* walls. Examples are Cabezas Largas (or Arena Blanca) at the Paracas peninsula (Engel 1966b:193-210, Tello & Mejía Xesspe 1979), the Topará occupation of Chongos (Peters 1987-88, 1997) and Dos Palmas in the Pisco valley (Canziani Amico 2009:296-297, Rowe 1963:10-11, Soldi 1995:99, Wallace 1971:83-84), and Pampa de Gentil in Chíncha (Canziani Amico 2009:292-295). Further sites with large *adobe* mound constructions are Huaca Santa Inés in Chíncha and, on a smaller scale, Alto de Molino in Pisco (Silverman 1997). Topará-style ceramics can also be found frequently in the NGD where it is almost always mixed with Ocucaje 10/Nasca 1 sherds (Hecht 2010:29), suggesting a close interaction and exchange amongst cultures.

Around 200 CE, the Nasca culture reached its peak and Cahuachi turned into a great temple city. Evidence of strong Nasca influence has been found all over the South Coast from Chíncha to Acarí and, to a much lesser degree, even in the Cañete valley (Menzel 1971, Ruales 2000:378) and in the Arequipa region (Häberli 2001). However, the precise character of this influence is still not well understood. Early scholars argued for a unified polity with Cahuachi as its capital (Rowe 1963, Strong 1957) while since the 1980s a loose confederacy of local chiefdoms was postulated, which was held together by a common religion (Carmichael 1995, Silverman 1993, Silverman & Proulx 2002). The recent works of the Palpa Project again support the model of a stratified society organized in a unified multi-valley polity, at least during this phase of heyday (Reindel & Isla Cuadrado 2001:313-314).⁴⁶ There is a general agreement that the Ica and Río Grande drainages constitute the Nasca heartland. In the Acarí valley, the great center of Tambo Viejo was originally classified as a Nasca settlement (Menzel 1993 [1954]:35-44, Riddell 1986), but newer studies attribute it to a local culture group known as Huarato which was influenced by but not identical with Nasca (Carmichael 1992, Valdez Cárdenas 2009). To the north, the Carmen ceramic and textile styles are strongly influenced by Nasca, but no pure Nasca settlements are known, either.

By about 300 CE, Nasca society seems to have faced a severe crisis. Cahuachi was gradually abandoned as were other important settlements, including Los Molinos (Reindel & Isla Cuadrado 2001) and Llipata (Browne n.d., Soßna 2012) near Palpa, Cordero Alto in Ica and Tambo Viejo in Acarí (Riddell 1986). In turn, new local centers came into power, like La Muña (Isla Cuadrado & Reindel 2006, Reindel & Isla Cuadrado 2001) and – at a later time – Parasmarcha in the Río Grande valley (Reindel 2009:455-456, Tomasto Cagigao et al. 2009), perhaps Cerro Soldado and later Tinguíña in Ica (Menzel 1971:86-93, Rowe 1963:11), and Chaviña in Acarí (Valdez Cárdenas 2000:21/2009). In turn, Ventilla in the Ingenio valley (Silverman 2002) seems to have been occupied continuously until the end of the Middle Nasca phase. Towards the Late Nasca phase, settlement patterns hint to a drastic population decline in the NGD (Silverman 2002:170-171, Soßna 2012) but to a possible increase or at least a concentration of people in larger settlements in other South Coast areas (Menzel 1971, Rowe 1963, Schreiber 1999:167-168).

Regarding ceramic production, the characteristic distinction between Paracas and Nasca is the introduction of pre-fire painting on Nasca wares. This requires a profound knowledge of the properties of mineral pigments and perfect temperature control during firing but the resulting pottery is extraordinarily fine and hard (Carmichael 1994). Nasca fineware vessels even seem to have outdone elaborate textiles as the principle high-status good. Apart from pottery technique, there are further changes that attest to the emergence of a new culture (Silverman & Proulx 2002:16).

The Nasca are famous not only for their fine pottery and textiles but especially for the geoglyphs crisscrossing the desertic *pampas*, slopes and ridges. These include straight lines, trapezoid shapes, and figures (contributors in Aveni 1990, Aveni 2000, Lambers 2006, Reiche 1976). The first geoglyphs had already been constructed during Paracas times, but the overwhelming majority, including all larger ones, date to the Nasca Period. Most were not constructed on slopes but on the plain pediment between the river valleys. Instead of anthropomorphic beings, zoomorphic and abstract figures were depicted, but these are much less frequent than the lines and trapezoids. The geoglyphs most probably played a prominent role in rituals linked to water and fertility (Lambers 2006, Reinhard 1988).

⁴⁶ Also see Llanos Jacinto 2009 for a recent study independent from the Palpa Project arguing for a unified Early Nasca polity.

Nasca burial customs were more uniform than those of the Paracas Period, though deviations from the norm are known. The articles by Patrick Carmichael (Carmichael 1995) and Johny Isla Cuadrado (2009:128-134) and the magister thesis by Niels Hecht (Hecht 2004) currently provide the most detailed overviews.⁴⁷ The three most common tomb types, generally all made for a single individual, are:

- Large jars containing the body that were placed in simple pits. In most cases, the deceased are children “placed in a seated posture, with legs flexed to the chest, or flexed in a lateral position” and often wrapped in plain cloths (Isla Cuadrado 2009:130).
- Floored tubular pits with a base of fine sand on which the body was placed in a flexed seated position. The shaft is filled in, but sometimes the mummy is protected by a kind of tilted roof of wooden beams
- *Barbacoa* tombs whose chambers are often lined with stones or *adobes*. The chamber is covered by a massive roof of wooden beams reminiscent of a grill (*barbacoa* in Spanish) and packed stones, mud, and leaves. In the Palpa region, the bodies in these graves were “placed in an extended, dorsal position, legs flexed to one side” (Isla Cuadrado 2009:131).

There are differences in the quantity and quality of grave goods which include textiles, tools, adornments, vessels, and food. The *barbacoa* graves tend to be richer than the first two types and in general this tomb type implies a relatively high social status.

Large elaborate elite tombs like those excavated by Isla and Reindel (2006) at La Muña represent a fourth type which is clearly not common. It is characterized by deep, ample, rectangular chambers with *adobe* walls, a massive *barbacoa* roof, and a roofed surface platform enclosed by an *adobe* wall. Although at La Muña all tombs were looted, some leftovers, including fancy gold necklaces, point to an extraordinary original richness. The existence of such graves strongly suggests a pronounced social stratification of Nasca society.

Some Nasca tombs contain headless bodies (e.g., DeLeonardis 2000) while at some sites deposits of specially treated human heads were found (e.g., Browne et al. 1993). These so-called trophy heads are often depicted on vessels, textiles, and even some geoglyphs and must have played an important role in Nasca world view and rituals. Whether the heads were actually taken from captured enemies is still debated (Proulx 2001, Williams et al. 2001). Recent genetic and isotope analyses suggest that they were taken from locals and not from foreigners (Bower 2008, Knudson et al. 2009).

Little research has so far been done in the *cabezadas*. The works of the Palpa Project point to a depopulation of the headwater areas of the NGD at the beginning of the Nasca Period but also to a rapid repopulation on a notable scale only a few centuries later, during the Middle Nasca phase. Settlements consisted of round stone houses and were often established at elevated positions. In the upper Tierras Blancas valley (SGD), Kevin Vaughn excavated the Nasca settlement of Marcaya which was also built of round and irregular stone structures similar to those in the *cabezadas* of the NGD (Vaughn 2000/2009). The architectural pattern markedly differs from the one observed at the foothills where structures are rectangular and built of *quincha* and *adobe*. Though the associated fineware ceramic is clearly Nasca style, the architecture might hint to cultural differences between foothill and upper valley/*cabezadas* dwellers.

Round stone structures were common in the more distant highlands of the Ayacucho region, where the Huarpa culture developed. To date, the Huarpa people are believed to have organized in several more or less independent chiefdoms that developed out of local precursors (González Carré 1982:65-77, Isbell 1997, Leoni 2009, Lumbreras 1974b:133-138). In the later phases, sites like Ñawinpukyo, Wari, and others evolved into larger centers with administrative and ceremonial architecture. At the same time, a strong influence from Nasca culture is observable in ceramic assemblages (Benavides Calle 1971, Knobloch 1989/2005, Leoni 2009, Menzel 1964:8-10, Ochatoma Paravicio & Cabrera Romero 2010, Paulsen 1983). Arguably, also the construction of agricultural terraces boomed, allowing a much denser population (Isbell 1977:9, Schreiber 1992).

⁴⁷ For primary data, especially from the SGD, see Kroeber et al. 1998 and Novoa Bellota 2002.

3.2.4.3. *The Wari Culture of the Middle Horizon (MH)*

The Middle Horizon (650 – 1000 CE) phenomenon has been subject to scientific debate since the works of Max Uhle (1959 [1918]) in the early 20th century.⁴⁸ All over the Central Andes, stylistic traits developed which show strong influences from either highland Ayacucho or the Titicaca basin. Sherds and whole vessels of these local styles can often be found alongside imported wares from one of these two regions. The great urban centers of Wari (Ayacucho) and Tiwanaku (Titicaca) were the seats of power of two distinct but somehow interrelated large-scale political entities. Wari presence was strongest in most of the Central Highlands, at the Central and South Coast, and the northern half of the Extreme South Coast, while the Southern Highlands down to Cochabamba in Bolivia and the southern half of the Extreme South Coast seem to have been dominated by Tiwanaku. The exact nature of the Wari and Tiwanaku polities is still debated. While some regions appear to have been under direct control of one of the two paramount centers, others might have been loosely allied or may only have maintained intense trade relations (contributors in Jennings 2010).

Wari presence on the South Coast is widespread, but still poorly researched. Concerning the valleys between Ica and Chincha, most known Wari artifacts originate from excavated tombs or surface collections (Kroeber & Strong 1965 [1924-1927], Kroeber et al. 1965 [1924-1927], Menzel 1964, Uhle & Kroeber 1965 [1924-1927], Wallace 1972:3). The *Programa de Investigaciones Arqueológicas Chincha* excavated some rectangular Wari stone structures at La Cantera in the Chincha valley which belong to a small administrative center, but aside from a short preliminary report (Alcalde Gonzales et al. 2001) no further publications are available to date. Martha Anders excavated parts of a Late Nasca and Early Wari settlement at Maymi in the Pisco valley where she found a deposit of broken Wari style vessels (Anders 1990/1994). The architecture, however, is built with *adobe* and *quincha* which is typical for the Nasca culture but not for Wari. A contemporary habitation site in the same valley was investigated by Raphael Santa Cruz (2007) at Miraflores 3A.

The apparent coexistence or immediate succession of the latest Nasca and the Early Wari occupations has also been observed in the Río Grande drainage. Conlee reports a Middle Horizon domestic occupation at the La Tiza site in the Nasca valley. Since the site was inhabited at least between 200 BCE-1476 CE, it also includes a Late Nasca occupation (Conlee 2010/2011). The Palpa Project also documented a number of Middle Horizon sites, which include a Late Nasca component, e.g., Huayuncalla (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013).

At Huaca del Loro in the Las Trancas (or Tunga) valley in the SGD, an unusual circular stone building associated with Late Nasca and Early Wari ceramic material was identified (Novoa Bellota 2002:93-96, Paulsen 1983, Schreiber 1988, Strong 1957). It was integrated into a complex of large angular compounds with domestic remains and built of field stones set in mud mortar but partly also of *adobes*, which was partly destroyed after 1957. Next to these structures, a badly looted cemetery was registered which apparently included Nasca elite tombs similar to but smaller than those of La Muña (Isla Cuadrado & Reindel 2006). The ceramic material from Strong's excavations, especially that originating from a waste midden, belongs to the styles Nasca 7, Nasca 8 and Nasca 9/Chakipampa and hence date to the transition between the Early Intermediate Period and the Middle Horizon (Paulsen 1983). A similar site is said to have existed at Tres Palos between the confluences of the Ingenio and Santa Cruz rivers with the Río Grande (Strong 1957:36-37), but no investigation has so far taken place.⁴⁹ The round structure is reminiscent of the so called East Plaza at Ñawinpujyo which is believed to belong to the late Huarpa occupation of the site (Leoni 2009/2010). This architectural parallel may therefore also hint to strong cultural relations between the populations of the Nasca drainage and the Ayacucho region some time *before* the emergence of the Wari.⁵⁰

As Paulsen (1983) argues, there is reason to assume that locals coexisted peacefully with immigrants from the Ayacucho region when the EIP slowly faded into the Middle Horizon. Soon, however, the last traditional Nasca merged completely with the highlanders before epoch 2 of the Middle Horizon (8th

⁴⁸ For an overview over the recent state of research see contributors in Bergh 2012, Isbell & McEwan 1991, Jennings 2010, and Kaulicke & Isbell 2000/2001.

⁴⁹ The site might have been related to Chiquerillo near the Grande/Ingenio confluence (Novoa Bellota 2002:207-216, Isla Cuadrado 2001b).

⁵⁰ Schreiber (Schreiber 1988) argues that round structures were also common in the middle and upper valleys of the Grande drainage, having in mind some dwelling sites with small and simple round houses. The large and carefully built structure at Huaca del Loro, however, was probably not a simple dwelling and it was surrounded by residential sectors with *angular* rooms. Quite obviously, Huaca del Loro does not compare to Schreiber's villages.

and early 9th century CE) when the Nasca region was probably ruled from Wari via local governors. During the Middle Horizon, no new geoglyphs were constructed, but the existing ones were respected and some of them stayed in use (Lambers 2006). This is another clear sign of cultural change occurring as a gradual transition.

Pure Wari sites, which can be attributed to the height of the Middle Horizon, are comparatively rare. Examples are Pataraya (Edwards 2010) and perhaps Pacheco (Novoa Bellota 2002:200-207) in the SGD, and Lambrasniyoc and Chilcapuquio in the NGD (Chapter 6.6). Furthermore, Helaine Silverman (Silverman & Proulx 2002:273-275) identified a compound of angular structures in the Ingenio valley as a possible Wari site. All these sites are modest in size, present compounds of orthogonal rooms and in some cases D-shaped structures, all built of stone. These installations most likely served administrative functions related to imperial rule. At the *cabezadas* of the NGD, the Palpa Project registered a number of further Wari sites that suggest a stronger Wari presence at higher altitudes. It is very possible that intense surveys in the headwater sections of the neighboring valleys would bear similar results, but these areas remain largely unexplored by archaeologists. Arguably, there were more Wari sites in the lower South Coast valleys too, which were either never recorded (or recorded but never published) or which have already fallen victim to the widespread and accelerating destruction caused by land claims and construction projects.

The burial customs on the South Coast changed in the Middle Horizon, but rather gradually, combining Nasca traditions with those probably introduced by Ayacucho highlanders. The best documented tombs of this time are located at sites in the Río Grande drainage (Isla Cuadrado 2001b/2009). Isla distinguishes three basic types: "simple or uncovered pits, *barbacoa* and roofed pits surrounded by a quadrangular stone structure, and roofed funerary chambers with a stone enclosure in the upper part" (Isla Cuadrado 2009:135).

The first of these tomb types resembles simple Nasca pit graves and usually contains a single body in a seated position. Such tombs, though poorly documented, have also been reported from Tambo Viejo in the Acarí valley (Niles-Hensler et al. 1988). Examples of the second, the *barbacoa* type, resemble the elite Nasca graves of La Muña and other sites but also show some differences. They are smaller, the chambers were generally not filled, the quadrangular surface structures are of stone, not *adobe*, and they are often arranged in a line, sharing a wall. The Nasca tombs, in turn, are usually separated by a free space. Most notably, the Middle Horizon version frequently contains more than one body. In many cases of multiple burials an adult is accompanied by one or several infants. The third tomb type features quadrangular chambers lined with field stones and covered by a massive *barbacoa* roof. These tombs also have rectangular surface structures with stonewalls up to 1.5 m in height. High-status tombs often contained mummy bundles, which are intentionally mummified bodies in a seated flexed position wrapped in elaborate textiles and often wearing feather headdresses (Isla Cuadrado 2001b). Again, multiple burials of adults together with one or several infants seem to have been the rule, as far as it can be judged from contexts disturbed by looting (Isla Cuadrado 2009).

Numerous tombs of the early MH, including many of types two and three were also excavated by Tello and Mejía, especially at Huaca del Loro (Las Trancas Norte), Los Médanos (Las Trancas Sur), and Pacheco in the SGD (Novoa Bellota 2002). Conlee (2010/2011) reports looted rectangular, but also some oval, tombs from the foothill site of La Tiza in the Nasca valley, which she attributes to the Middle Horizon. These seem to correspond by and large to Isla's second type. The agglutinated graves with rectangular surface structures excavated by Lothrop and Maler (1957) in Chaviña (Acarí) can also be assigned to the second type.

Interestingly, burials at the *cabezadas* differed greatly. Contrary to earlier phases, not all tombs were subterranean. Small stone houses, so called *kuntis*, were also common. These are generally rectangular in shape and contain the bones of numerous individuals, many of which having deformed skulls. As these graves are easily recognizable, practically all of them have been opened and disturbed during the last centuries, but it is likely that they were also reopened frequently in ancient times to deposit additional bodies. Very often only skulls and long bones are observable, which indicates secondary internment.

Recent excavations at Huayuncalla in the *cabezadas* of the NGD have revealed several different types of MH graves, including large circular funeral structures with a ledge and a central sunken quadrangular chamber, carefully paved with flat stones (Castro de La Mata Guerra García et al. 2012). This layout resembles the circular structure at Huaca del Loro, which perhaps might actually be a tomb. In the Ayacucho region (the Wari heartland) burial types and customs are manifold and have been

resumed by Isbell (2004) and Valdez et al. (2002/2006).⁵¹ Multiple burials and accessible stone chambers are well known, but in these cases the chamber itself is generally subterranean. Free-standing small stone houses are not common.

The causes for the demise of the Wari realm are still not well understood. Wari seems to have lost control over most of its actual or would-be provincial administrative centers between 800-1000 CE with the core area around the city of Wari itself being the last bastion (Isbell 1997). The NGD suffered severe depopulation around 800-900 CE when all known Wari centers in the region were abandoned. Schreiber (Schreiber 1992:34-36) lists a number of potential factors that may have played a role in the decline of the Wari political system and finally in the demise of the city of Wari itself, including an excessively costly imperial administration, invasion by a foreign power, disease, and climatic deterioration. In the end, only intensified archaeological investigation in the wider Ayacucho area can be expected to reveal the data necessary for a better understanding of what happened to Wari and its people at the end of the Middle Horizon.

3.2.4.4. Cultures of the Late Intermediate Period (LIP)

With the final breakdown of the Wari and Tiwanaku polities and the disappearance of their influence in distant areas, a restless time of regional developments began. It is characterized by more or less profound cultural changes, apparently significant migration movements, and widespread warfare. This so-called Late Intermediate Period (1000-1470 CE) lasted until the incorporation of most of the Central Andes into the Inca Empire during the second half of the 15th century CE.⁵² A general characteristic of that time seems to be that most ethnic groups were divided into several largely autonomous sub-groups often fighting each other and uniting only in the event of external threats. Contrary to all earlier periods, some oral tradition survived into the early colonial period and, having passed through several filters, found its way into chronicles and administrative documents. Although these sources should be used carefully and critically, the information may occasionally help to link archaeological remains to historic records. In some cases, this allows speaking of actual ethnic groups and political entities rather than of mere archaeological cultures. Nevertheless, the most important source of information is still the material remains.

The most important and best known polity of on the South Coast was surely the one centered in the Chincha valley (Menzel & Rowe 1966, Rostworowski de Diez Canseco 1977, Sandweiss 1992). The capital of La Centinela/Tambo de Mora still preserves large monumental *adobe* and *tapia*⁵³ mounds and high enclosure walls as do several other contemporaneous complexes (Canziani Amico 2009:410-424, Wallace 1998, Uhle & Kroeber 1965 [1924-1927]:63-86, Wurster 1999:146-152). The Lords of Chincha are known from ethnohistoric sources to have been wealthy and powerful thanks to their domination of maritime trade along the Peruvian coast (cf. Menzel & Rowe 1966, Rostworowski de Diez Canseco 1977). There is, however, a certain chance that the Chincha only acquired such a position due to their status as favored Inca allies and that they may have been far less powerful before the Inca expansion. At least, there is no evidence that the Chincha also directly controlled the neighboring valleys of Pisco and Ica, or even the Río Grande drainage (Conlee et al. 2005:222-229, Menzel & Rowe 1966:63-67). The people living there surely shared a similar culture but their societies seem to have been less hierarchical and complex.

The ruins of a major LIP settlement in the Pisco valley can be found directly adjacent to the great Inca complex of Tambo Colorado, but these do not include monumental or special purpose architecture. Dozens of further sites were briefly described by Wallace (1971) but no excavations or detailed surveys were carried out. In Ica, the preserved monumental architecture is sparse and of much smaller scale than in Chincha although there are a number of simpler LIP settlements. The site of Ica La Vieja, also known as Tacaraca or Tajaraca, is seen as the capital of an independent chiefdom in the Ica valley (Kroeber et al. 1965 [1924-1927]:122-123, Menzel 1976:12-26/1977:8-18, Uhle 1913). A certain degree of (perhaps only temporary) political unification of the northern South Coast via asymmetric alliances rather than direct control is nevertheless possible but hard to prove from the archaeological record.

⁵¹ Also see Leoni 2010 for a number of excavated burials of diverse types from the site of Ñawinpukyo.

⁵² See Conlee et al. 2005 and Covey 2008 for recent overviews over important LIP cultures in the Central Andes.

⁵³ *Tapia* are large blocks of compacted or rammed clay.

LIP settlements in the Río Grande drainage were built by the Nanasca people. They are often large but lack any kind of monumental architecture comparable to the mounds and platforms in the northern valleys. At the foothills, they predominantly consist of agglutinated angular fieldstone structures connected by streets and passageways and are often protected by walls or natural topography or both. The perhaps best-known example of this type is the site of Huayurí in the Santa Cruz valley (Novoa Bellota 2002:230-231, Kroeber et al. 1998:39, Neudecker 1979, Ubbelohde-Doering 1958). Between the Palpa and Río Grande valleys the LIP settlement of Pinchango Alto was documented by the Palpa Project and a 3D model was produced by specialists from the ETH Zürich (Eisenbeiss 2009, Reindel 2005). In the SGD, Conlee's work at the small village of Pajonal Alto constitutes the only detailed investigation on an LIP settlement, though many others are known superficially (Conlee 2000/2006).

Farther to the south, Kroeber (1944:22-23) reports occurrences of Ica style sherds in the Acarí and Yauca valleys as does Menzel (1993 [1954]). The settlement pattern in Acarí is summarized by Menzel who states that "[t]here was no monumental site built in the native tradition comparable to La Centinela in Chíncha and Old Ica [Tacaraca]. Sahuacari and Otaparo, the largest concentrated native settlements, are no more than good sized villages, without imposing monumental buildings" (1959:131).

Hardly any research has been dedicated to settlements at the *cabezadas* although these are numerous, often extended, and mostly well preserved. Construction patterns are markedly different from those at the foothills: houses are generally round and often arranged on terraces surrounding a hilltop. Since in the entire Río Grande drainage no site exists which would classify as the capital of a drainage-wide polity, it seems likely that power was split between a number of small, either competing or perhaps (at least temporarily) allied, chiefdoms.

The settlements at the *cabezadas* of the Río Grande drainage can be attributed to the Rucanas people (also spelled Lucanas) who occupied the upper valleys and the adjacent *puna* on both sides of the continental divide. To the northeast their settlement area bordered that of the related Soras (Abraham 2010, Meddens & Schreiber 2010, Mölders 2010, Schreiber 1993). This area includes extended and highly productive agricultural terraces in the valleys, which are supplemented by vast grazing grounds in the *puna*. The Rucanas are mentioned in several early colonial documents and chronicles, but most information concerns the situation under Inca and Spanish rule (Abraham 2010, Guillén Guillén n.d., Meddens & Schreiber 2010, Mölders 2010, Schreiber 1993). Rucanas settlements in the *cabezadas* of the NGD are associated with low quantities of Ica style ceramic sherds while the bulk of the surface material consists of plain, non-diagnostic coarseware. In turn, the Andamarca region on the opposite side of the *puna* had its own decorated ware (Schreiber 1993:80-82). The architecture, however, is largely identical in both regions. Many Rucanas settlements have defensive walls and are located on hilltops. After Cieza, the Rucanas also had to defend against raids by the Chínchas, who "did great harm to the Soras and Lucanas" (Cieza de León & Pease 2005 [1553]:202 (Chapter LXXIV)).⁵⁴

Relatively little published information is available on LIP burial customs on the South Coast. Uhle excavated a number of tombs near the old Chíncha capital, but he paid little attention to describing the graves themselves (Kroeber & Strong 1965 [1924-1927], Uhle & Kroeber 1965 [1924-1927]:87-90). Generally, most tombs had a chamber which was carved out horizontally either directly into the vertical front face of a natural terrace or parting from the bottom of a deep vertical pit. In most cases, the graves contained multiple burials. Canziani (Canziani Amico 2009:420-422) describes semi-subterranean, rectangular elite tombs in the Chíncha valley, which were made of stone or *tapia* and apparently designed for reentry. Such tombs, though badly looted, are also still observable at the LIP settlement next to Tambo Colorado in the Pisco valley. In Chíncha as well as in Pisco, they always contained several individuals.

In Ica, Uhle excavated a number of LIP graves, but in most cases he concentrated on grave goods, especially ceramic vessels, and did not document the contexts as a whole. Only for the Soniche cemetery more detailed information is given (Menzel 1976:17-23/1977:8-28, Kroeber et al. 1965 [1924-1927]). After Menzel, urn burials were the rule also for adults. In elite tombs, the principal dead was placed in an urn while several bodies of young adults and children, perhaps servants or relatives, were placed around him. The principal body often shows clear signs of secondary treatment, especially of red painting on the bones (1977:8-28). The deeper and richer tombs were originally marked at the surface by a carved wooden post, which was cut down and buried when the tomb was definitely

⁵⁴ My translation. Original reads: "[...] hicieron gran daño en los soras y lucanas [...]."

sealed (Menzel 1977:21-22). Most of the tombs opened by Uhle, however, belong to the Late Horizon and the early colonial period.

In the Río Grande drainage, no systematic studies on LIP burials have been undertaken. In the NGD, the remains of looted LIP graves can be observed at many sites, but almost all tombs seem to have been simple pits containing a single mummy in a seated flexed position wrapped in plain or sometimes painted cloths. No elaborate elite tombs like those from Chíncha, Pisco, and Ica are known. At Pacheco in the SGD, Tello and Mejía excavated some other simple pit graves in cemetery C (Novoa Bellota 2002:203). LIP burials in the Río Grande drainage, at least at the foothills, thus resemble the settlements in that they are numerous but relatively simple and do not reflect a pronounced social stratification. Proulx, however, reports that LIP tombs from the lower Río Grande valley “tended to be large, deep and rectangular in shape, often with adobe lining” (2007:8). Certainly, more research is necessary to gain a more complete picture of LIP tombs at the coast and at the foothills.

The situation is different at the *cabezadas* where large round stone houses for multiple burials known as *chullpas* were erected in or next to important settlements. They somehow seem to continue the customs known from the Middle Horizon, though the shape of the structures changed from rectangular to round. Although almost all *chullpas* have been looted, the disturbed bones can often still be found inside. Burials can also be found in small caves or below rock shelters (*machay*) closed by walls, though in many cases the dating of these contexts is not clear (Reindel et al. 2008:59:135-141).

3.2.4.5. *The Inca Culture of the Late Horizon (LH)*

The Late Horizon is defined as the epoch during which the Central Andes were incorporated into the Inca Empire. As different provinces were established at different times, the exact beginning of the epoch varies from region to region but most conquests occurred during the reign of Pachacutec (1438-1471) and the first years on the throne of his successor Topa Inca (1471-1493). The major campaigns essentially concluded with the victory over the Chimú Empire at the North Coast in 1476 (Rowe 1946). The Spanish-led conquest of the Inca Empire started in 1532 and by 1533 most of the former Inca reign was under the control of the *conquistadores* and their numerous native allies. The last Inca refuge in the Vilcabamba area west of Cusco, however, was not taken before 1572. In sum, the temporal core when most of the Central Andes was firmly under Inca rule only comprises about half a century (1476-1532 CE).

Much of the South Coast was apparently annexed within the scope of the same campaign that brought the Soras and Rucanas under Inca control. Ethnohistoric sources⁵⁵ tell of stiff battles between Inca and Soras while there is no clear evidence that the Rucanas were involved in the fighting (Meddens & Schreiber 2010, Mölders 2010, Schreiber 1993). It is very possible that they surrendered peacefully when facing the overwhelming superiority of the imperial army. There is some debate whether the campaign was led by Pachacutec or by one of his generals almost immediately after the conquest of the Chanka territories in the Huancavelica region (around 1440 CE) or by Topa Inca in the early 1470s (Julien 2008, Menzel 1959, Rowe 1946).

The inhabitants of the valleys of Nasca, Ica, and Pisco seem to have surrendered without major fighting while those of Chíncha resisted. Miguel Cabello Valboa, Bernabé Cobo, and El Inca Garcilaso de la Vega tell of military engagement.⁵⁶ Pedro Cieza de León states that the Chínchas himself told him that they reached a peaceful agreement with the Incas while natives from other ethnic groups informed him about a great war (Cieza de León & Pease 2005 [1553]:427-428 (Chapter LIX)). It is also possible that the fighting refers to a first, unsuccessful attempt of conquest in the 1440s and the peaceful surrender to the arrival of the army of Topa Inca in the early 1470s. In any case, the privileged status of the Lord of Chíncha under Inca rule argues against a major clash causing great losses to the Inca army.

The Inca administration of the South Coast differed from valley to valley but in general, local elites stayed in power and were only supervised by an official from Cusco (Menzel 1959). While in more rebellious provinces forced population exchange and military occupation were the rule, such measures

⁵⁵ Cieza de León & Pease 2005 [1553]:402 (Chapter XLVII), Cabello Valboa 1951 [1586]:304 (3rd part, Chapter XV).

⁵⁶ Cabello Valboa 1951 [1586]:338 (3rd part, Chapter XVIII), Cobo & Mateos 1964 [1653], vol. 2:81 (2nd book, Chapter XIII), Garcilaso de la Vega & Urtega 1941 [1609]:160-167 (6th book, Chapters XVII and XVIII).

were not taken on a major scale in case of the South Coast (Rankin 1994).⁵⁷ In Chincha, a large Inca administrative compound was added to the existing capital at La Centinela (Uhle & Kroeber 1965 [1924-1927]:75-80, Wurster 1999:153) and another, smaller one to Tacaraca in Ica (Menzel 1959:128/1976:12-15). In both cases, direct Inca presence in the respective valleys seems to have been limited to the residence of the representative of the Sapa Inca⁵⁸ and his staff and perhaps the establishment of a temple to the sun, the principal Inca deity.

The situation is different in the Pisco valley for two reasons: first, no capital with administrative facilities comparable to La Centinela and Tacaraca already existed, and second, the Pisco valley provided the best connection between the coast and the highlands. The Inca built a major road leading from Cusco over Vilcashuamán and through the Pisco valley to Chincha, but very likely this route had already been in use for many centuries or even millennia (Hagen 1978, Hyslop 1984, Proyecto Qhapaq Ñan 2006). At least four major Inca sites are known: Lima La Vieja and Tambo Colorado at the foothills, and Huaytará and Incahuasi in the *cabezas*. Incahuasi seems to have been a kind of royal spa including baths, and may have served as a road stop for important travelling officials (Wurster 1999:173). At Huaytará, the finely dressed stonewalls of an apparent temple, now integrated into the local church, can still be clearly seen, as well as the walls of some other associated structures (Baranza Lescano n.d., Rosales Huatuco 1978, Uhle et al. 2005 [1902], Wurster 1999:166-173).

The principal site of storage and administration surely was Tambo Colorado, where a large complex of storehouses and a palace were erected directly adjacent to an existing major settlement (Canziani Amico 2009:493-496, Kroeber 1944:41, Protzen 2006/2008, Uhle et al. 2005 [1902], Wurster 1999:156-165). Lima la Vieja seems to have been another native settlement which was amplified by Inca architects to serve as an administrative center (Hyslop 1984:111-112, Soldi 1995). Hyslop assumes that it served to control coastal traffic while nearby Tambo Colorado supervised movements of goods and people to and from the highlands. Lima la Vieja also served as the preliminary capital of the Viceroyalty of Peru for a few months in 1534, before the foundation of Lima in 1535.

In the Nasca drainage, a small administrative center or governor's residence was built in the foothill section of each major valley: Tambo de Huayurí in the Santa Cruz valley, Pueblo Nuevo (Tambo de Llipata) in the Río Grande valley (Novoa Bellota 2002:212-214, Reindel 2009:458-460), Tambo de Collao in the Ingenio valley (Hagen 1978:208, Menzel 1993 [1954]:53-55, Silverman & Proulx 2002:282), Paredones in the Nasca valley (Novoa Bellota 2002:197-199, Canziani Amico 2009:496-498, Menzel 1959), and Poroma in the Las Trancas valley (Novoa Bellota 2002:197-198). The complexes in the Río Grande, Ingenio, and Las Trancas valleys are now completely destroyed but are still observable in old aerial photographs. In the foothill section of the study area, there are several additional minor Inca sites, often directly adjacent to older LIP settlements but there is only one clear Inca administrative center in the *cabezas*. It forms part of the site of Santa María, overlooking an extended complex of agricultural terraces. It consisted of only three buildings and was much smaller than the principal centers downstream. Apparently, direct Inca control focused on the *yunga* and the coastal road between Chincha and Acarí.

In Acarí, Tambo Viejo was erected as one of the major coastal administrative centers, comparable in scale to Tambo Colorado. There were further habitation sites close by, which apparently were already occupied before the Late Horizon (Menzel 1993 [1954], Menzel 1959). In Yauca, Inca administration had its seat in Tambo de Jaqui (Menzel 1993 [1954]:53).

It bears repeating that information on Late Horizon burial contexts is sparse. The general cultural continuity between LIP and LH on the South Coast suggests that burial customs did not change significantly, at least not for commoners. Members of the ruling local elite naturally had much closer contact to the Inca officials and hence were more influenced by their culture. For Chincha, where horizontally carved out chambers had been the rule, Uhle states that "[w]ith the entrance of the Inca civilization, the [tomb] type changed, and we find graves of the Inca period excavated cylindrically 3 to 4 meters deep and the bodies set around the walls at the bottom" (1965 [1924-1927]:90).

⁵⁷ Garcilaso de la Vega mentions that some Nanasca were resettled to the lower Aparímac valley at the Andean east flank, northwest of Cusco, because they were well adapted to a hot climate. But he also explicitly states that these *mitmaquna* were only few in number because of the limited arable land available along the steep river banks (1941 [1609]:276, 3rd book, Chapter XIX).

⁵⁸ The term *Inca*, though it is now used for the whole people of Cuzco, originally referred only to the members of the noble families. The "king" himself held the title of *Sapa Inca* (meaning "the only Inca" in the sense of "peerless").

Some more detailed information is available from the Soniche cemetery in Ica where Uhle had excavated a number of LH tombs of commoners and nobles. Menzel, who had access to his unpublished field notes, summarizes the data as follows:

Burials of commoners are shallow, unstructured interments in the sand, without provision for re-entry [while those of nobles were] [...] deep and large, excavated through approximately 12 feet [3.7 m] of drift sand into the clay subsoil of the valley. The main grave chamber of each tomb was a rectangular room cut into the hard, moist clay. These chambers were evidently meant to be dwellings for the dead, for they were provided with lattice roofs of poles and thatch. The standard size of the chambers found by Uhle varied from about 6 feet by 6 feet [1.8 by 1.8 m] in area and 3 feet [0.9 m] in depth to 14 feet by 9 feet [4.3 by 2.7 m] in area and 7 feet [2 m] in depth. The chambers contained several dead, sometimes 12 or more. One or two large entry steps, and in one tomb a zig-zagged access way about 18 feet [5.5 m] long, were built to make entry into the chambers easier and perhaps more ornate. (1977:9)

The richest tombs, however, were the first ones to be plundered by the Spaniards. No scientifically investigated Late Horizon elite tombs are known from the Río Grande drainage. Simple pit burials of commoners, in turn, may have contained the same material as in pre-Inca times and would thus be difficult to distinguish from Late Intermediate Period tombs.

When in 1528, Inca Huayna Capac (1493-1528) and his designated heir both suddenly died of disease while campaigning in Ecuador, a war for succession broke out between two other sons of the deceased ruler. Atahualpa, who had accompanied his father, assumed command over the northern army and had his major power base in north Peru and Ecuador while his half-brother Huascar, who had stayed in Cusco, controlled the resources of the Inca heartland and was supported by much of the Cusco nobility.

The Rucanas and probably also the South Coast peoples seem to have fought on Huascar's side. At least, the Rucanas took part in the great battle of Yanamarca, near Jauja, which ended with a decisive defeat of Huascar's army (Murúa & Ballesteros Gaibrois 1987 [1611-1616]:184-185 (first book, Chapter LII)).⁵⁹ Shortly after, Atahualpa won the final battle and took his opponent prisoner. The war had raged for five years and had left many provinces devastated (D'Altroy 2003:76-83, Rostworowski de Diez Canseco 1988:148-178) but the South Coast, including the *cabezas*, does not seem to have been affected directly.

Shortly after Huascar's defeat, a small Spanish war party led by Francisco Pizarro landed at Tumbes in northern Peru.⁶⁰ Pizarro took advantage of the still unstable political situation via changing alliances with the different factions (Rowe 2006). In Cajamarca, the *conquistadores* managed to take Atahualpa prisoner in a risky coup. After his execution, the Spanish supported the Huascar side and had Manco Inca, another son of Huayna Capac, crowned as a puppet ruler. Manco, however, soon launched a rebellion against the Spanish but was finally defeated and retreated to the largely inaccessible Vilcabamba region west of Cusco.

In the following years, the Spanish managed to establish and consolidate their supremacy by making and breaking alliances and playing off the tensions between the various ethnic groups and factions, pitting them against each other. Even when the *conquistadores* started to fight amongst themselves (1537-1542), the native lords supported different Spanish parties. In later years, the potential for native resistance was severely weakened not only by segmentation but also by drastic depopulation, especially of the coastal regions. In the case of Chincha, Menzel and Rowe deduce from colonial sources that:

[t]he native population declined catastrophically in the half century following the conquest, from over 30,000 heads of households in 1533 to 979 counted in 1583. The decline was probably a reflection of a combination, of epidemics of diseases of European origin, such as measles and smallpox, and famine resulting from the disruption of native organization produced by years of destructive warfare. Severe general epidemics are reported for Peru for 1546 and 1558, and famines occurred in 1539 and 1548. All coast valleys in Peru showed a heavy loss of population in the 16th century, but Chincha was one of the valleys which suffered the most. (1966:69)

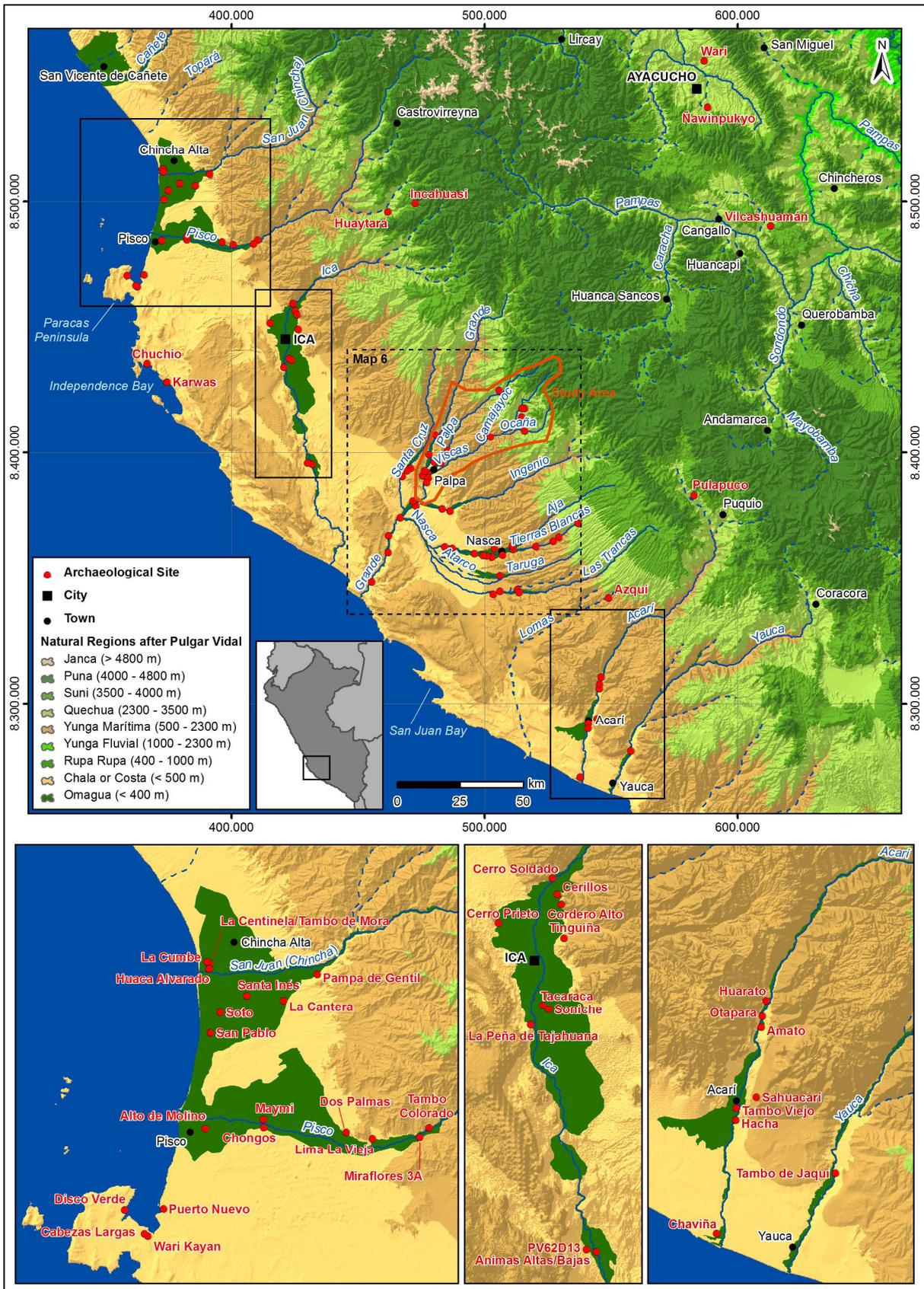
There is no reason to assume that the neighboring valleys, including the Río Grande drainage, were less affected, because these should have suffered from the same hazards. Cieza de León even explicitly states that "the wars of the past consumed with their cruelty [...] all of these poor indios.

⁵⁹ Cf. Mölders 2010:71-73 for further indirect indications in colonial documents.

⁶⁰ A good recap of the events during the years 1532-1572 is given by Morris and von Hagen (2011:234-244), D'Altroy (2003:311-321), and Rowe (2006).

Some Spanish of credit told me that the greatest harm which came upon these indios causing their destruction was the quarrel between the two governors Pizarro and Almagro about the limits and terms of their governorates, which had been so costly [...]" (2005 [1553]:204 (Chapter LXXV)).⁶¹

⁶¹ My translation. Original reads: "Las guerras pasadas consumieron con su crueldad [...] todos estos pobres indios. Algunos españoles de crédito me dijeron que el mayor daño que a estos indios les vino para su destrucción fue el debate que tuvieron los dos gobernadores Pizarro y Almagro sobre los límites y términos de sus gobernaciones, que tan caro costó [...]."



Map 7: Mentioned archaeological sites on the South Coast and the adjacent highlands. See Map 6 for details of the Río Grande drainage. Map: VS.

4 Culture Meets Nature

In any context, the natural environment and human cultural development are closely interrelated. Human societies often heavily modify the landscape, and environmental parameters fundamentally influence human subsistence, movement, and behavior. This relationship is the research field of cultural ecology, which is to a large degree rooted in the pioneering works of Julian Steward (1938). By now, it also includes several new theoretical and methodological branches developed during the last 80 years (Bargatzky 1986, Ellen 1982, Sutton & Anderson 2010). For the reconstruction of non-literate past societies the theoretical concepts of cultural ecology are of great value (Butzer 1982) although interpretation exclusively based on material remains is necessarily much less accurate than the description of a living community based on the real-time observation of behavior and the interrogation of informants. In this chapter some general theoretic considerations about the dependence of societies on natural resources will be presented before turning on to the specific case of the Central Andes, and in particular, of the study area.

4.1 The Impact of Resource Availability on Culture

Aside from providing a great variety of resources, nature also has a strong influence on religion and world view (contributors in Gottlieb 2010 and Taylor 2008). Some religious practices constitute spiritual means of insuring the availability of crucial resources. In the Andes, for example, the worship of mountain peaks is often linked to a water and fertility cult (Glowacki & Malpass 2003, Reinhard 2002). The importance of water, in turn, stems from the need to produce food, e.g., by rain-dependent agriculture or irrigation farming.

The relation between natural resources and culture is therefore basically economic in character and can be explained in terms of supply and demand (Tainter 1988). Nature *supplies* a variety of resources potentially exploitable by humans. People, in turn, *demand* certain material goods. This includes the most obvious needs for food, water, clothing, housing, and essential tools along with culturally desirable goods such as luxuries and ceremonial objects. People can meet their demand by exploiting the natural resources of the environment they live in, or by obtaining goods from distant areas by peaceful trade or by using force to raid or to extort tributes. Some environments offer a few resources in great abundance while others are lacking completely. A group inhabiting such an environment may choose to specialize on what is readily available. The generated surplus can then be exchanged with societies that have access to goods unavailable locally.

Which resources are considered worth exploiting, how they are exploited, and at what scale, all depend upon culture. Only some of the totality of potentially available resources will actually be used. For example, not everything edible and nutritious is accepted by everybody as food and there is often a distinction between low status and high status food.⁶² Some goods are highly valued because they play an important role in rituals. In pre-Hispanic times, the warm water *Spondylus* oyster (*Spondylus princeps*) was traded over large distances from the coasts of Ecuador all over the Andes, because it was a religious symbol linked to fertility cults (Carter 2011, Murra 1975b). With the introduction of Christianity by the Spaniards, the demand for *Spondylus* collapsed completely. Luxuries are even more subject to particular traditions and also to temporal fashions. They may be of great value for a certain cultural group but regarded as cheap and ordinary by another, e.g., glass pearls offered by European merchants to native tribal societies in North America (Dubin 1997:271-274).

If *per capita* consumption remained stable, then the amount of required resources and hence the scale of exploitation would simply be proportional to population size. This may not be the case, however, when goods can be acquired more easily due to new technologies and strategies, because the surplus might not only be used to maintain more people but also to increase per capita consumption. In many societies, not only the access to prestige goods but also the consumed and redistributed quantity of every-day goods defines the social status of an individual (e.g., the potlatch feasts practiced by northwestern American tribes, Beck 1993). This may lead to extensive wasting in order to gain prestige. Since the measure of returning to a more rational use of resources in times of scarcity will be

⁶² Cf. Fox n.d., especially Chapter 2. Mintz et al. (2002) give an overview about recent literature on the cultural aspects of food consumption.

perceived as a loss of living standard and social status, it will be avoided as long as possible. On the other hand, the resources which nature has to offer are not stable either. Mines may eventually be depleted, soils exhausted, forests clear cut, game and fish populations over-hunted and over-fished. All of these scenarios would be direct consequences of unsustainable human exploitation. Some of these effects are reversible, others are not.

There are two further important factors outside the ambit of human control: climate and geology.⁶³ Although events such as earthquakes and volcanic eruptions may cause heavy destruction and loss of life, they only constitute single events, limited to a certain region. While this is also true for occasional storms, floods, torrential rains, short-term droughts, and unexpected frosts, long-term changes in climatic conditions have much further-reaching consequences (cf. Clare & Weninger 2010). Climate affects all organic resources (whether produced or foraged) directly and indirectly by determining the amount and distribution of precipitation, the length of growth periods, the limits of habitats, and so on. Rates of wind and water erosion may also fluctuate. While mineral deposits can only diminish, resources like arable land, forests, water, game, etc. can also recover or increase under especially favorable climatic and environmental conditions or by human landscape engineering.

Given the volatility of demand for and supply of resources, no stable equilibrium can be expected on the long run. While a growing resource base offers the possibility of population growth and increased *per capita* consumption to human groups, shrinking resources can cause serious problems to societies that are already exploiting them to maximum. Possible lines of solutions to such challenges are:

- 1) *Accessing new sources.* This is applicable to all resources that are not rare or localized (as are certain minerals and ores). New sources can be accessed by widening the catchment area, by using marginal, less productive resources, or by migrating into still un- or under-exploited regions. A widening of the catchment area can be reached by splitting groups into smaller dispersed units (satellites), by increasing the time investment for the exploitation of distant resources, or by increased movement speed, e.g., by the construction of roads and bridges, or the use of mounts (horses, camels, elephants).
- 2) *Increasing productivity via new technologies or strategies (intensification).* This is predominantly applicable to organic resources (hunting, farming, herding, foraging). For example, yields per hectare can be raised by means of using fertilizer, breeding and growing more productive crops, or employing irrigation. Increasing productivity can be sustainable or not. In the first case, the quantity of resources remains stable or grows, while in the second, the raise in productivity is reached by depleting the reproductive base, resulting in short term surplus but long-term resource exhaustion. Classical examples would be over-hunting and over-fishing, and clear-cutting of forests.
- 3) *Substituting or diversifying resources.* This is applicable to most types of resources. For example, people living close to the shore can replace agricultural products - at least partly - by fish and other seafood and vice versa. Tools normally made of metal can be made of stone, wood, or bone instead; hides can replace textiles, and so on. Substitution, however, in most cases means a loss of productivity and functionality, or at least of social status and prestige in the framework of certain cultural values.
- 4) *Reducing per capita consumption.* This is particularly applicable to all resources necessary to provide non-vital goods such as luxuries. A reduction of investment in communal social institutions (political-administrative and religious) also decreases resource use. Societies with a high degree of non-vital consumption thus have the biggest potential for retrenchment. A decrease in *per capita* consumption of food is limited by the minimum number of calories needed for human survival.
- 5) *Permanently reducing demand via population control.* This measure decreases the need for all kinds of resources and can be achieved by migration, birth control, or, in extreme cases, by starving to death or physically exterminating competing groups by means of war.

When available resources no longer suffice, one or several of these five strategies will have to be pursued. Even if a society did not respond to the situation, this would simply mean that its members would starve to death and this would be their unintended "solution." Obviously, not all options are

⁶³ The present-day influence of human activities on world climate only takes effect because of the large number of people (seven billion), the massive burning of fossil fuels, and large scale deforestation. All of these phenomena are limited to the last two centuries of human history. On a local and regional scale, however, deforestation may also have affected climate in the past.

available to all groups of people in all environments and situations. If possible, options 1) and 2) will probably be the first choices while options 3) to 5) should be regarded as emergency measures.

When archaeologists and historians find evidence that a past society had to reduce consumption to a great extent and suffered heavy population losses, they generally speak of crisis, decline, or collapse. The literature on the topic is abundant, but two recent articles, one by Guy Middleton (2012) and another by Joseph Tainter (2006), offer detailed reviews and discussions of different perspectives and interpretations of the phenomenon.⁶⁴

Two highly influential works especially have fueled recent debates about cultural responses to situations of long-term resource shortages: Joseph Tainter's *The Collapse of Complex Societies* (1988) and Jared Diamond's *Collapse: How Societies Choose to Fail or Succeed* (2005). Both authors analyze case studies of past societies that faced such crises. Diamond's general reasoning can be summarized as follows: When population - and therefore the demand for goods - increases, resources become scarce, no new resources are available, and migration is not possible, then people have two basic options:

- They can take measures to reduce *per capita* consumption or the number of consumers or they can substitute or diversify resources early on.
- They can consume the reproductive base of potentially renewable resources in an unsustainable way. In the long run, this will inevitably lead to collapse ("ecocide").

Diamond's book, however, is of popular character. It depicts scenarios of what its author considers likely to have happened in the past, but it does not present a thorough theoretical framework.⁶⁵

In contrast, Tainter developed a detailed and sophisticated theory about economic factors underlying major breaks in cultural development. Tainter defines *collapse* as:

[...] a political process. It may, and often does, have consequences in such areas as economics, art, and literature, but it is fundamentally a matter of the sociopolitical sphere. A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity. The term 'established level' is important. To qualify as an instance of collapse a society must have been at, or developing toward, a level of complexity for more than one or two generations. [...] The collapse, in turn, must be rapid - taking no more than a few decades - and must entail a substantial loss of sociopolitical structure. Losses that are less severe, or take longer to occur, are to be considered cases of weakness and decline. (1988:4)

Accordingly, the level of complexity is crucial. For Tainter, complexity refers to "such things as the size of a society, the number and distinctiveness of its parts, the variety of specialized social roles that it incorporates, the number of distinct social personalities present, and the variety of mechanisms for organizing these into a coherent, functional whole. Augmenting any of these dimensions increases the complexity of a society" (1988:23).

Later on, he lists constituents of complexity which include "agriculture and resource production, information processing, sociopolitical control and specialization, and overall economic productivity" (pp. 93-94). In this sense, scale and sophistication of production and extraction contribute to the overall complexity as does the degree of administration, organized religion, military organization, and social stratification. From here on, I will draw on Tainter's definitions when using the terms *collapse* and *complexity*.

Tainter emphasizes that societies are generally problem solving organizations: if a society fails to respond to stresses because it chooses to take no or inadequate measures, then it has to be asked which were the cultural factors that hindered finding a solution. In other words, a single event as well as a process of worsening environmental or social and political parameters can only trigger a collapse when cultural factors prevent a society from successfully dealing with the challenge.

⁶⁴ Also see Tainter (1988) for an exhaustive discussion of numerous works and approaches published before 1988.

⁶⁵ Much of Diamond's work has been rejected by scholars specialized either in the cultures he used as case studies (contributors in McAnany & Yoffee 2010) or in the phenomenon of collapse itself (Middleton 2012, Tainter 2006), principally for two reasons: 1) In some of his cases, the archaeological record in fact does not argue for an unambiguous scenario of catastrophic collapse after Diamond's own definition but for long-term cultural adaption or migration. Diamond just ignores facts that do not fit into his model. 2) The images he draws of his case-study societies are often too coarse-brushed, one-sided, and lack profound understanding of the particular cultures. Diamond's apparently poorly researched popular article in *The New Yorker* about tribal warfare in Papua New Guinea further fuels this critique (Balter 2009).

Tainter bases his model on economic theories about productivity, outlined by Hadar (1966) and Hailstones and Mastrianna (1988), which focus on average and marginal products, where “[t]he average product of an economic activity is simply the output per unit of input. The marginal product of any input is the increase in the total output resulting from the input. Similarly, the average cost is the cost per unit of input, while the marginal cost is the increase or decrease in total cost resulting from one more (or less) unit of input” (Tainter 1988:92).

Later on, he replaces the term “product” with the more general “return” which is not limited to the production of goods but refers to all kinds of benefits including security and welfare. He argues that while complexity is still low and resources readily available an increase in a society’s investment (time, labor, money, etc.) in complexity leads to an increased average return. After a while, however, the rate of increase in productivity – the marginal return – goes down and may eventually turn negative. At a certain point, any further investment in complexity will actually *decrease* the average return. From then on, a society’s resilience starts shrinking, making it more vulnerable to any kind of stress.

Finally, a catastrophic event that would previously have been dealt with effectively can trigger a collapse. If this happens, it is not the severity of the event itself which prevented a successful handling of the crisis but the instability of the affected society. Worsening environmental factors as well may operate as an ultimate trigger for the collapse of a society, but its deeper causes nevertheless lie in the culture, namely in the level of complexity. As collapse means a drastic reduction of complexity (and often also of population), it also implies that *thereafter* marginal returns are likely to rise again. Provoking collapse, e.g., by revolting against ruling elites, may therefore even be a conscious strategy of some segments of a society to reestablish a favorable cost-benefit relation for the maintenance of a certain level of complexity (Tainter 1988:118-123).

In in the present study it will also be asked, whether or not there are any signs indicating a collapse in the regarded 3000-year cultural sequence and, if the answer is yes, if, speaking with Diamond, people failed to make the right choices when facing environmental problems or if, as Tainter might argue, collapse was just the better alternative to further increasing complexity at too high a cost. After these general considerations, the specific situation of man-environmental relationship in the Central Andes and especially the study area in the Northern Río Grande de Nasca drainage shall be addressed.

4.2 Particularities of Human-Environmental Relationships in the Central Andes

Economic human-environmental relationships in the Andes are a vast topic which cannot be treated in detail in the scope of the present study. A recent overview of theories concerning the economies of pre-Hispanic societies in Peru is given by Peter Kaulicke (2008:151-196).⁶⁶ Before continuing forward, two peculiarities of the Central Andean environment should be considered which are especially crucial for understanding the interaction between nature and culture in this unique landscape setting.

Firstly, maritime resources along the coast are extraordinarily abundant and provide a highly productive food source, especially at some “hot spots” such as the Paracas peninsula. In 1975 Michael Moseley published his well-known study *The Maritime Foundations of Andean Civilization* in which he argues that the earliest complex societies on the Peruvian coast based their subsistence economy predominantly on seafood while farming was marginal and largely limited to the industrial crops cotton and gourd, used to fabricate fishing nets and floaters. At the Peruvian coast, maritime resources alone must have sufficed to support large and permanent early settlements while the cultivation of staple crops was a later development. Moseley’s thesis had been challenged by other authors but recent studies seem to reconfirm it (Sandweiss 2009). Although irrigation farming became dominant in food acquisition for most coastal societies since the Initial Period, fishing remained extremely important throughout history, including modern times.

The second peculiarity is the unique diversity of so many different environments, each with its particular resources, within a very short distance.⁶⁷ The desertic Pacific coast and the Amazonian rain forest

⁶⁶ Kaulicke’s chapter is about the economy during the Formative (Initial Period and Early Horizon), but he also discusses some much more general approaches not bound to a specific region or time section.

⁶⁷ 84 out of 103 of the Earth’s life zones after the Holdridge-Tosi classification system can be found within the borders of present-day Peru (INRENA 1994).

are separated by only 250-500 km, and in between sit the Andean mountains, presenting almost all possible altitudinal steps. This landscape enables people to diversify their economy by directly making use of the potentials of several different environments or by exchanging goods with nearby neighbors who nevertheless have access to a completely different set of resources. This also minimizes the risk of famine due to crop failures in a given environment because the loss can be compensated to a certain degree by the unaffected harvests in another region. Accordingly, the organization and often institutionalization of exchange systems has been crucial for arguably all sedentary Andean societies, though we have more detailed information only for some groups of the last centuries before the Spanish Conquest and of later times.

In 1972, John Murra published his influential study *El control vertical de un máximo de pisos ecológicos en la economía de las sociedades andinas* (Murra 1975a, also see Murra 1985a). Based on early colonial documents, in this essay he presents five cases of late pre-Hispanic ethnic groups of different size and complexity from the highlands and from the coast. Each of these groups possessed permanent colonies in different ecological niches far away from its respective core territory. The colonists did not lose ties with their home communities but formed part of their extended and diversified economic systems. It is not clear, however, to what degree the same concept may have applied to societies in the more distant past (Murra 1985b).

Murra's study triggered broad ethnohistorical and archaeological research on the topic of complementarity all over the Central Andes. As a result, numerous variants of the vertical control model were described or proposed for different regions and societies (e.g., Farrington 1984, contributors in Masuda et al. 1985). For the Southern Highlands and the Extreme South Coast, Núñez and Dillehay (1995) developed a model for earlier pre-Hispanic epochs based on a network of principal market settlements ("asentamientos-ejes") connected by regularly operating llama caravans which could transport goods over considerable distances. In several aspects, they draw on approaches originally developed by David Browman (1984/2008) who stressed the importance of camelids in the long-distance exchange system.

Jürgen Golte (2001) described the strategy of cultivating fields at different altitudes successively, as each environment has its own agrarian cycle. In this case, each family may possess fields in several ecozones and temporarily moves close to those that need to be cultivated or harvested during a specific season. In her study of the Lupaqa ethnic group in the western Titicaca region, Mary van Buren demonstrated that the vertical archipelago strategy actually served to supply social elites with high-status goods usable in political negotiations, etc., rather than complementing the daily diet of commoners. She argues that "barter and exchange, perhaps between people who were ethnically distinct, may have been a more important element in prehistoric household subsistence practices than is currently acknowledged" (1996:348).

Whatever the precise strategies – (semi-)nomadism, colonization, interethnic trade/exchange, or a combination of these – it is reasonable to assume that the acquisition of a wide range of products from different ecozones had always been desirable to all inhabitants of the Central Andes. For this reason, no society can be fully understood if seen only in the environmental context of its immediate core territory. The resources that were available nearby will nevertheless have been especially important. In the case of farming societies inhabiting the study area between 1500 BCE-1532 CE this particularly concerns arable land and water for the cultivation of *yunga* and *quechua* crops. In some phases the grasslands of the *puna*, which served as pasture for camelids, were also essential.

4.3 Past Climate and Its Impact on the Agricultural Potential

As outlined in the Chapter 2.1, the pre-Hispanic inhabitants of the Río Grande drainage potentially had access to a great variety of natural resources, either directly or indirectly via trade and exchange. The supply, however, may have varied through time due to source depletion, disruption of trade routes, and a diminished agricultural potential. Since the Initial Period, agricultural products undoubtedly made up the biggest part of the diet, though hunting, fishing, and herding was also important.

The most important climatic factors for agricultural production are precipitation and – at high altitudes – temperatures during the growing season. Ideally, precipitation is not only sufficient on aggregate but also well distributed over the course of the growing season, and temperatures do never fall below 0°C. Deviations from this ideal situation can be compensated to a certain degree, for example by storing

water in reservoirs, by breeding especially frost tolerant crops, or just by producing and storing a significant surplus in good years which can be consumed in cases of crop failures. If unexpectedly strong, frequent, or prolonged deviations from the norm occur, farming societies may not have enough time to adapt and may slip into a serious crisis causing population decline and the dissolution or drastic change of social order and political and religious institutions.

Accordingly, the impact of climate change on agriculture needs to be examined in some detail. Recent studies in South Columbia have shown that ecozones frequently shifted by several hundred altitudinal meters throughout the Holocene, sometimes within a single century (González-Carranza et al. 2012). Though the climatic regime in South Peru is different, the frequency and amplitude of such shifts, including those of the limits of agriculture, may have been at least similar. Due to the extreme aridity and the resulting sensitivity to changes in absolute values, especially with reference to precipitation, ecozone shifts may have been even more pronounced. The possible amplitude of change of the principal climate factors and the resulting impact on ecozone borders as well as on the extent of agriculturally usable land shall be discussed in the following.

4.3.1 Precipitation

Precipitation patterns are a highly complex matter and depend on many locally diverse factors, particularly air movements, latitude, cloud cover, altitude, topography, and so on (c.f. Barry 1992). Accordingly, "it seems unwise to quote regional altitudinal moisture trends as 'altitude phenomena', as such gradients could also be studied in non-mountain regions. Specific regional moisture gradients are best addressed as such, although they might locally be following an altitudinal gradient" (Körner 2007:572).

In the study area and on most of the Central Andean west flank, such an altitudinal gradient is indeed observable. Due to the fact that no reliable long-term measurements of precipitation available along a transect from sea level up to the highest peaks are available, it cannot be said if the relation between precipitation and altitude can be expressed by a general mathematical function, e.g., a linear or an exponential one. Any precipitation values for altitudes between those at which the few meteorological stations are located have to be interpolated and can thus only be regarded as very rough estimations.

Judging from observations on vegetation development (Mächtle 2007), the precipitation increase with altitude seems to be best described by an exponential function, at least between about 2000 and 4000 m.a.s.l. The actual (unknown) course of the graph, however, may deviate from that of an exponential function. It may be much steeper for lower altitudes and may flatten at higher elevations. In those zones, a linear model might apply better, though this is purely hypothetical. For a comparison, annual precipitation amounts will be interpolated according to both, a linear and an exponential model, none of which should be misunderstood as fact data based on measurements.

The increase of precipitation per altitudinal meter (precipitation gradient) can be calculated if both variables (altitude and precipitation) are known for at least two places at different heights. After Mächtle and Eitel, the isohyet of 200 mm accumulated annual rainfall marking the desert margin under today's hyper-arid conditions runs roughly along the 2000 m isohypse, which may serve as the first reference (Mächtle & Eitel 2013:Figure 1). In addition to the desert margin, a second date should be taken from a distant highland site to cover the entire altitudinal span. There is, however, no local long-term precipitation data available for the *puna* ecozone. The closest stations at which such data has been recorded are Pacococha (4356 m.a.s.l.) and Accnocochoa (4520 m.a.s.l.) in the headwaters of the Pisco and San Juan (Chincha) rivers.⁶⁸ During the observation period from 1942-1950, the average accumulated annual precipitation at Pacococha was 992 mm while at Accnocochoa the corresponding value for the period 1948-1978 is 756 mm. The mean would be 874 mm. Accordingly, altitudes at 4400 m.a.s.l. should receive about 880 mm. Given the relative proximity, a similar value can be assumed for the *puna* above the Río Grande drainage.

In a linear model, absolute values can now be calculated as follows: As the altitudinal difference between 2000 m.a.s.l. (desert margin) and 4400 m.a.s.l. is 2400 m and the difference in accumulated precipitation amounts to $880 \text{ mm} - 200 \text{ mm} = 680 \text{ mm}$, precipitation should increase by $680 \text{ mm} / 2400 \text{ m} = 0.28333 \text{ mm/m} \approx 0.28 \text{ mm/m}$. All data used in this calculation is estimated and the resulting value should not be considered an exact constant. Based on this calculation, the border between

⁶⁸ See folder "ClimateData" on Supplement DVD 1.

yunga and *quechua*, which runs at 2300 m.a.s.l. and thus 300 m above the desert margin should receive $300\text{ m} * 680\text{ mm}/2400\text{ m} = 85\text{ mm}$ more than the 200 mm of the desert margin, say 285 mm. This border also tentatively marks the lower limit of rain-dependent farming if special techniques for optimal water storage are applied. Cultivation will be risky, however, because in years with below-average precipitation, crop failures will be severe. Reliable large-scale rain-fed farming becomes possible above approximately 2700–3000 m.a.s.l., depending on local microclimate, where annual rainfall should accumulate to more than 350 mm. Precipitation at the *quechua-suni* border at 3500 m.a.s.l. would accumulate to $200\text{ mm} + (1500\text{ m} * 680\text{ mm}/2400\text{ m}) = 625\text{ mm}$, and at the transition between *suni* and *puna* at 4000 m.a.s.l. the calculation would result in $200\text{ mm} + (2000\text{ m} * 680\text{ mm}/2400\text{ m}) = 767\text{ mm}$ (Table 1).

Borders between Ecozones	Precipitation (exponential model)	Precipitation (linear model)	Altitude under hyper-arid conditions	Estimated altitude under different conditions			
				hyper-arid to arid	arid	arid to semi-arid	semi-arid
desert margin	200 mm	200 mm	2000 m.a.s.l.	1625 m.a.s.l.	1250 m.a.s.l.	875 m.a.s.l.	500 m.a.s.l.
Lower limit for risky rain-fed farming	241 mm	285 mm	2300 m.a.s.l.	1925 m.a.s.l.	1550 m.a.s.l.	1125 m.a.s.l.	800 m.a.s.l.
lower limit for reliable rain-fed farming	371 mm	483 mm	3000 m.a.s.l.	2625 m.a.s.l.	2250 m.a.s.l.	1875 m.a.s.l.	1500 m.a.s.l.
chala-yunga	79 mm	0 mm	500 m.a.s.l.	125 m.a.s.l.	-	-	-
yunga-quechua	241 mm	285 mm	2300 m.a.s.l.	1925 m.a.s.l.	1550 m.a.s.l.	1175 m.a.s.l.	800 m.a.s.l.
quechua-suni	505 mm	625 mm	3500 m.a.s.l.	3125 m.a.s.l.	2750 m.a.s.l.	2375 m.a.s.l.	2000 m.a.s.l.
suni-puna	687 mm	767 mm	4000 m.a.s.l.	3625 m.a.s.l.	3250 m.a.s.l.	2875 m.a.s.l.	2500 m.a.s.l.

Table 1: Assumed relation between accumulated annual precipitation and altitude under hyper-arid (present-day), arid, and semi-arid (14th century CE) conditions. Table: VS.

For an exponential model, the growth factor F has to be calculated in a similar way as the interest rate is determined in financial calculations, though in this case the intervals do not refer to time but to altitude and the factor is not given in percent.⁶⁹ Intervals of 50 altitudinal meters should be appropriate, which means that the number of intervals n_F between the two reference points at 2000 and 4400 m.a.s.l., respectively, is $(4400-2000)/50 = 48$. If P_{4400} is the annual precipitation at 4400 m.a.s.l. (880 mm) and P_{2000} is the annual precipitation at 2000 m.a.s.l. (200 mm) then:

$$F = \sqrt[n_F]{P_{4400} / P_{2000}} = \sqrt[48]{880\text{ mm}/200\text{ mm}} \approx 1.03135$$

Now, it is possible to calculate the precipitation P_x at any altitude x (rounded to 50 m), where the number of intervals is $n_x = (4400-x)/50$, with the formula:

$$P_x = P_{4400} / F^{n_x}$$

Precipitation at the *quechua-suni* border at 3500 m, for example, would be calculated as:

$$880\text{ mm} / 1.03135^{(4400\text{ m}-3500\text{ m})/50\text{ m}} \approx 505\text{ mm}$$

The values for all ecozone borders are given in Table 1. In Figure 9 the resulting graphs for the linear and the exponential model are compared.

In order to get an idea of the possible amplitude of the shifting of ecological zones through time, a comparison can be made with a well-known humid phase. The best data for such an epoch is available for the Late Intermediate Period (1000-1470 CE). At the site of Huayurí in the Santa Cruz valley, some ten kilometers west of Palpa, Bertil Mächtle et al. (2009) identified structures belonging to a *khadin*-like system for water harvesting which was radiocarbon-dated to 1262-1292 CE (Mächtle et al. 2012, Mächtle & Eitel 2013:66). Similar systems are in use today in other parts of the world, and it is known that they need a minimum amount of 100-150 mm of annual precipitation to work effectively (Mächtle et al. 2009). Mächtle et al. therefore deduce that in the second half of the 13th century CE precipitation at the altitude of Huayurí (500 m.a.s.l.) accumulated to about 150 mm per year. Today, the amount lies below 10 mm. It is probable that the actual precipitation even exceeded 150 mm during much of the LIP (Chapter 2.2.3). During the 14th century CE, the 200 mm isohyet marking the desert margin may have run through Huayurí along the 500 m contour or even at a lower altitude – a difference of 1500 altitudinal meters compared to today.

⁶⁹ If a start capital K_0 accumulates to an end capital K_n in n years by adding yearly interests, then the interest rate p in % is calculated as: $p = [\sqrt[n]{K_n/K_0} - 1] * 100$. Since in case of the precipitation gradient the factor is not given in %, the formula could simply read: $p = \sqrt[n]{K_n/K_0}$. The variables referring to financial calculations should be renamed, however.

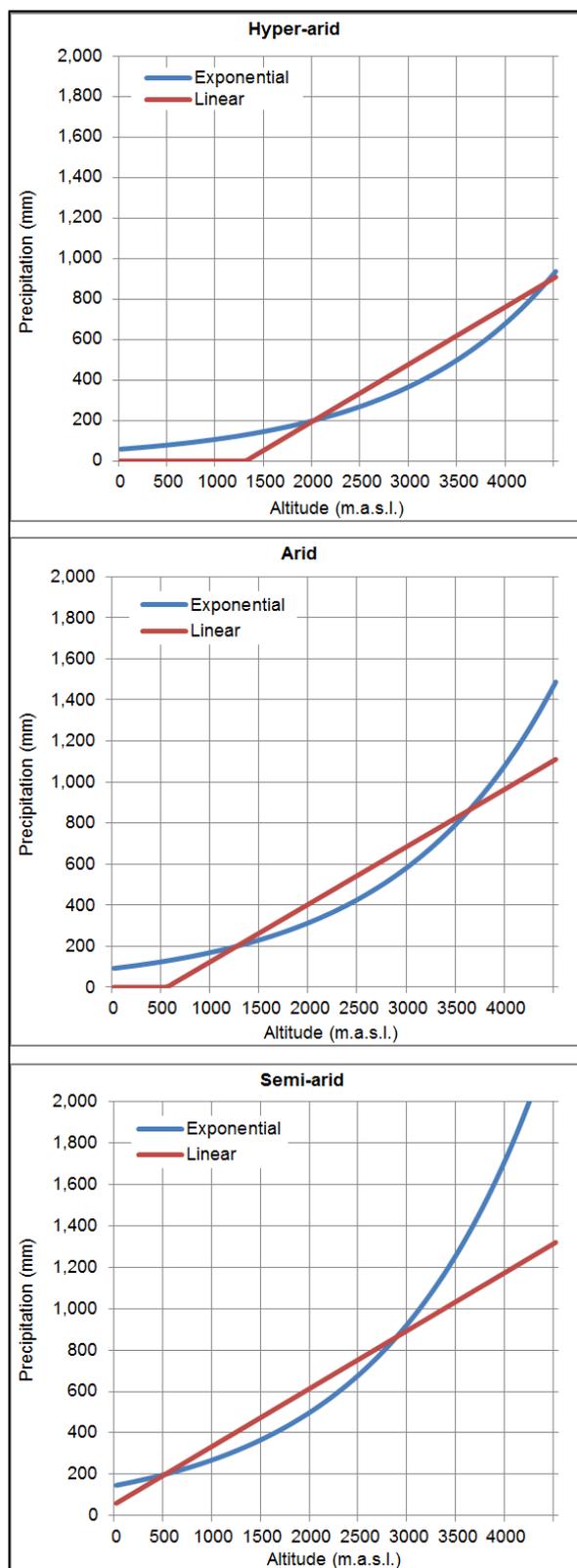
Figure 9: Relation between altitude and precipitation after a linear and an exponential model under different climatic conditions. The terms hyper-arid, arid, and semi-arid refer to the assumed situation around the town of Palpa (350 m.a.s.l.). Graphics: VS.

It can be assumed that all borders between ecological zones will also have shifted by 1500 m. This is obviously a simplification, though an inevitable one, because of the general paucity of meteorological data not allowing for a more refined model. If today's climate⁷⁰ is considered hyper-arid while it was probably semi-arid during the 14th century, then under arid conditions, the ecozone borders may have run roughly halfway (750 altitudinal meters) between both extremes (Table 1). Whenever the ecozone borders drop by more than 500 altitudinal meters, the *chala* merges with the *yunga* zone in terms of moisture conditions (Map 8), although, in reality, the very coast will have been a special case always due to the close-by ocean and its influence on local wind, temperature, and moisture regimes. Accordingly, the presented models are more suitable for inland areas.⁷¹

4.3.2 Temperature

Besides precipitation, the second crucial climatic factor for the agricultural potential of these ecozones is temperature. Although in the study area average temperatures have always been relatively high due to its proximity to the equator, the limiting factor for agriculture is nightly frosts at high altitudes during the growing season (January to May) which can cause severe damage to crops. The average monthly minimum temperatures during that period (AMMTGS)⁷² can be regarded as the crucial factor. In the following, I will call the isotherm corresponding to 0°C AMMTGS the frost margin. *Average* means that frosts still do occur during some especially cold nights but they are relatively rare. Cultivation of frost tolerant crops, especially some potato varieties, should be possible at the frost margin and the risk of a dramatic failure due to frost damage in an exceptionally cold year is still passable.

Changes from cold to warm periods are generally even more difficult to reconstruct from geoarchives than shifts from humid to arid conditions. Although little is known about changing temperature patterns in the study area during the last



⁷⁰ It has to be cautioned that Pulgar Vidal defined his ecozones in the late 1970, but given the pace of recent climate change, the situation may have changed noticeably during the last 40 years, creating a certain offset of perhaps a few dozen meters in the altitudinal limits. For now, I will assume that this offset is negligible, given the general uncertainties of the data.

⁷¹ A complete table holding the interpolated values after the linear and the exponential model corresponding to 50 m altitudinal intervals can be found in the "EcozoneShifts" folder on Supplement DVD 1.

⁷² Average Monthly Minimum Temperature during the Growing Season.

3500 years, it is unlikely that mean temperatures varied by more than a few degrees, judging from large-scale global and continental perspectives (Jones & Mann 2004, Kellerhals et al. 2010, Mann et al. 2008, Mann & Jones 2003, Negendank 2004). The changes of the day/night and summer/winter amplitudes, and thus of the extreme temperatures, due to orbital parameters and variations in sun activity may have been somewhat more pronounced (Dincauze 2000:149-152). Since regional temperature patterns may vary from generalized continental or global ones, preferably local archives should be used to investigate the development in the study area. Isotope analyses may give some hints but have not yet been realized.

In the case of temperatures, a linear relation to altitude can be assumed in broad terms, although local microclimates may deviate.⁷³ For the purpose of model building, a temperature gradient can be calculated by comparing 20th century data from the coast and from the highlands in a manner similar to the way the precipitation gradient was determined. The stations closest to the study area with a reasonably long observation period are Pisco (1948-61) at 9 m.a.s.l. and close to the shoreline, and again Accnocochoa (1947-61) at 4520 m.a.s.l. Accordingly, the altitudinal difference between both stations is 4511 m. At the former, the long-term AMMTGS is 17.32°C and at the latter -2.40°C. The temperature gradient can be calculated by dividing the temperature difference (19.72°C) by the altitude difference: $19.72^{\circ}\text{C} / 4511\text{ m} \approx 0.00437^{\circ}\text{C} / \text{m}$ (Table 2). Taking the altitude of Accnocochoa as reference, the AMMTGS at any altitude can be interpolated by multiplying the altitudinal difference to Accnocochoa with the gradient, and adding the AMMTGS at Accnocochoa. In case of the *yunga-quechua* border, the formula would read: $(4520\text{ m} - 2300\text{ m}) * 0.00437^{\circ}\text{C} / \text{m} + (-2.4^{\circ}\text{C}) \approx 7.30^{\circ}\text{C}$ (Table 3).

		Monthly Minimum Temperature during Growing Season					
Station	Altitude	Jan	Feb	Mar	Apr	May	AMMTGS
Accnocochoa	4520 m.a.s.l.	-4.4°C	-2.0°C	-1.5°C	-1.6°C	-2.5°C	-2.40°C
Pisco	9 m.a.s.l.	17.9°C	18.9°C	18.7°C	16.7°C	14.4°C	17.32°C
Difference	4511 m	22.3 K	20.9 K	20.2 K	18.3 K	16.9 K	19.72 K
	Temp. gradient	0.0049 K/m	0.0046 K/m	0.0045 K/m	0.0041 K/m	0.0037 K/m	0.00437 K/m

Table 2: Calculation of the temperature gradient during the growing season taking measurements between 1947 and 1961 from two stations in the Pisco valley as reference data (calculated values rounded). Table: VS.

Borders between Ecozones	AMMTGS	Altitude (1950s)	Altitude AMMTGS +2°C	Altitude AMMTGS +1°C	Altitude AMMTGS -1°C	Altitude AMMTGS -2°C	Altitude AMMTGS -3°C	Altitude AMMTGS -4°C
frost margin	0°C	3971 m.a.s.l.	4428 m.a.s.l.	4200 m.a.s.l.	3742 m.a.s.l.	3513 m.a.s.l.	3284 m.a.s.l.	3055 m.a.s.l.
chala-yunga	15.17°C	500 m.a.s.l.	957 m.a.s.l.	728 m.a.s.l.	271 m.a.s.l.	42 m.a.s.l.	-	-
yunga-quechua	7.3°C	2300 m.a.s.l.	2758 m.a.s.l.	2529 m.a.s.l.	2071 m.a.s.l.	1843 m.a.s.l.	1614 m.a.s.l.	1385 m.a.s.l.
quechua-suni	2.06°C	3500 m.a.s.l.	3957 m.a.s.l.	3728 m.a.s.l.	3271 m.a.s.l.	3042 m.a.s.l.	2813 m.a.s.l.	2584 m.a.s.l.
suni-puna	-0.13°C	4000 m.a.s.l.	4458 m.a.s.l.	4229 m.a.s.l.	3772 m.a.s.l.	3543 m.a.s.l.	3314 m.a.s.l.	3085 m.a.s.l.

Table 3: Assumed relation between the average monthly minimum temperature during the growing season and altitude under recent conditions and interpolated values for conditions between 2°C warmer and 4°C colder. Table: VS.

Compared to the decades around 2000 CE, the 1950s, during which the reference data were generated, were a relatively cold phase, at least if seen from a worldwide perspective (Anderson & Goudie et al. 2007:194-197). The decade was nevertheless warmer than most of the 3500 years before. This, however, refers to annual *mean* temperatures and not to minima, which may have varied to a larger degree. For now it shall be assumed that the AMMTGS during the last millennia were probably rarely higher than 2°C or lower than 4°C, compared to the 1950s. This hypothesis remains to be tested against more concrete data (hopefully available soon).

The isohypse corresponding to a given temperature can be calculated by subtracting from the altitude of a reference station the difference of the temperature in question to that at the reference station, divided by the gradient. If the gradient stayed more or less stable over time, this calculation is also possible for temperature patterns different from that of the 1950s. Under conditions 4°C colder than in the 1950s, for example, the AMMTGS at Accnocochoa at 4520 m.a.s.l. would have dropped to -6.4°C. Taking Accnocochoa as reference, the isohypse marking the *yunga-quechua* border (AMMTGS = 7.30°C) should have run at 1385 m.a.s.l.: $4520\text{ m} - (7.30^{\circ}\text{C} - (-6.4^{\circ}\text{C}))/0.00437^{\circ}\text{C} / \text{m} \approx 1385\text{ m}$. The isohypses corresponding to the other ecozone borders can be determined accordingly and the same process can be repeated with different reference temperatures. Table 3 shows the results for AMMTGS values differing from those during the 1950s by +2 °C, +1 °C, -1 °C, -2 °C, -3 °C, and -4 °C.

⁷³ See Barry 1992:259-266 for some case studies and an overview of factors causing deviations from a linear relation.

4.3.3 Variability

The variability of climatic conditions directly affects the predictability of temperature and precipitation patterns in a given place. The more extreme and more frequent the deviations from the normal values, the higher the risk that a cultivated field will render no or only low yields due to frost damage or insufficient water supply. For rain-dependent farming, the risk increases with proximity to the frost margin or to the *yunga-quechua* border, corresponding to the 285 mm isohyet after the linear interpolation model and to the 241 mm isohyet after the exponential one (cf. Chapter 4.3.1). In the case of irrigation farming, the distance from the headwaters is crucial, as the discharge of a river will decrease the more fields are irrigated with its water along its upper course. In both cases, under unstable conditions fields in especially risky areas will be abandoned first. Population pressure may nevertheless force farmers to take high risks in the hope of a good year, but this means that in a bad year all or most of the seed deployed in risky areas is lost, resulting in a decrease of the average multi-year yield per unit of seed. With shrinking surpluses, capacities to build up buffer storage are also lowered, as is the amount of potential trade goods.

To get an idea of climate variability, attention should first be drawn to the situation during the 20th century, for which at least some data from meteorological measurements is available, though they are patchy and sometimes unreliable. Unfortunately, there are hardly any reliable multi-decadal data for temperature or precipitation in the highlands. The only information for the *cabezadas* above the South Coast available in the FAO database (FAO 2001) comes from the station of Accnocochoa in the headwaters of the Pisco river at 4520 m.a.s.l. For temperature, only the average monthly values for the years 1947-1961 are given, but not the individual values of each year. As a consequence, no statement can be made about the range of deviation from the norm and the frequency of extreme years.

Fortunately, at least the accumulated monthly precipitation for the years 1947-67 was recorded for each month separately. As can be seen from Figure 10, the values vary considerably from month to month and from year to year. For example, in 1950 precipitation did not exceed 100 mm per month even at the height of the rainy season (February/March), but it also never dropped below 80 mm for four months (January to April), providing a stable water supply. In turn, in 1955, precipitation was abundant between January and March but dropped below 50 mm in April. This distribution had limited the available irrigation water just during the last weeks before harvest. In terms of agriculture, a pattern similar to 1950 is more favorable, although the accumulated yearly amount of 644 mm was much lower than in 1955 (818 mm).

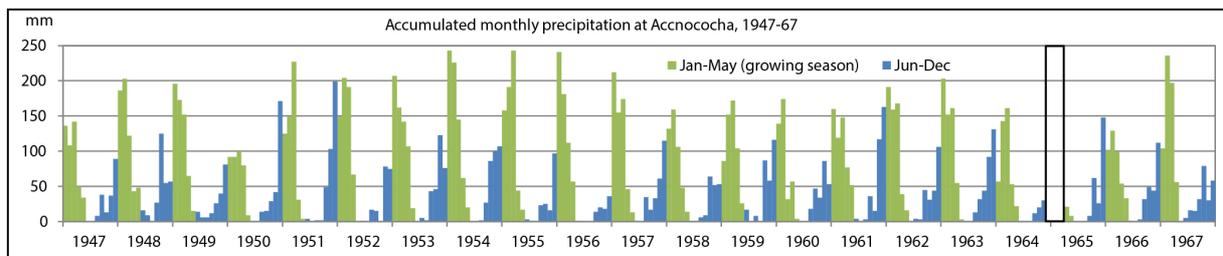


Figure 10: Accumulated monthly precipitation at Accnocochoa after data derived from the FAO database (FAO 2001). The data between December 1964 and March 1965 are missing. Graphic: VS.

For the lack of a close-meshed grid of meteorological stations with reliable data from a multi-decade observation period, the river discharge volume may serve as a proxy instead when comparing drainage systems. The discharge depends on local rainfalls in the highland catchment area and has been measured more or less continuously for most rivers since the 1930s. The data published by ONERN in the 1970s (1970/1971a,b,c/1975) can be used to compare the diverse South Coast valleys. Figure 11 shows the combined annual discharge volume of all major South Coast rivers for the 35-year period between 1934 and 1968, except for the Acarí and Yauca rivers for which data is only available from 1948 onward.⁷⁴ If the latter two are not considered, the values vary between 714 mio m³ (1968) and 5065 mio m³ (1946). This means that the volume of the most humid year exceeds that of the driest year by seven times. The seesaw pattern with the irregular succession of relatively moist and very dry years illustrates well the general unpredictability of precipitation levels.

⁷⁴ The data and charts presented in this and the following sub-chapters can be found in the Excel® workbook "AgriculturalPotentialSouthCoast.xlsx" in the "ClimateData" folder on Supplement DVD 1.

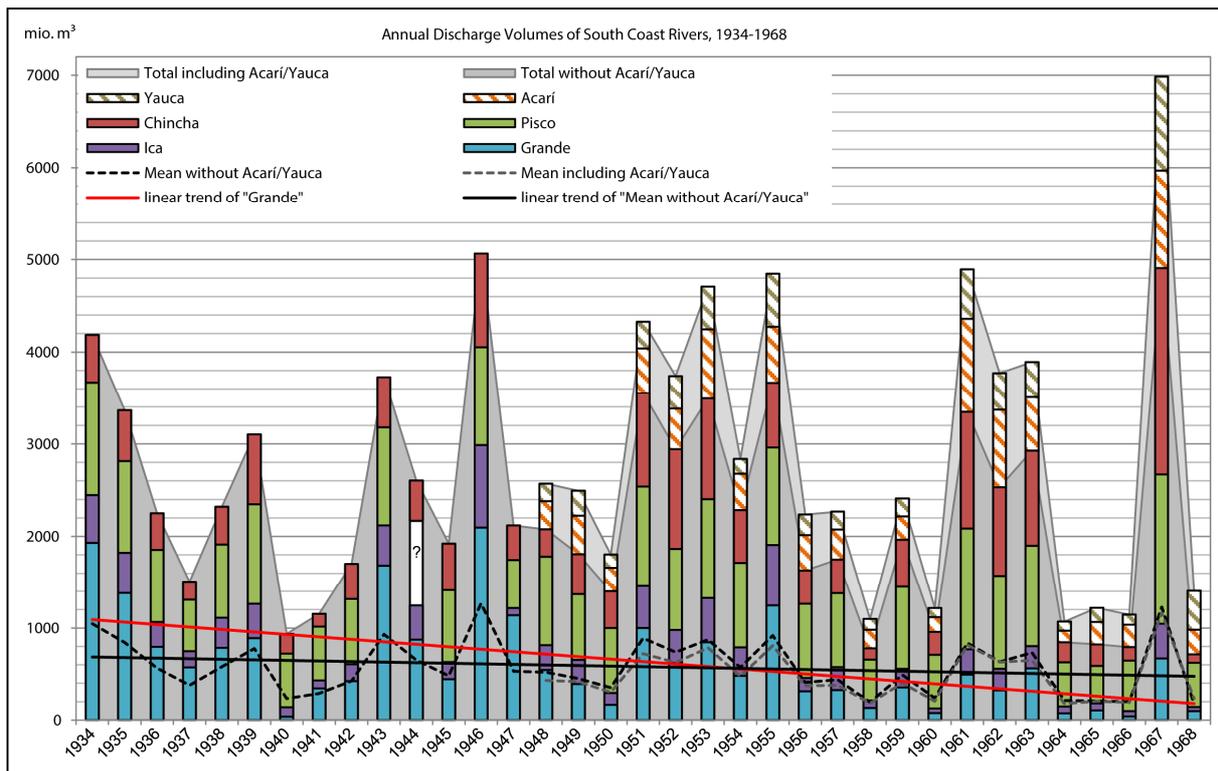


Figure 11: Annual discharge volumes of South Coast rivers between 1934 and 1968 after the data published by ONERN (1970/1971a,b,c/1975). Note the significant inter-annual and inter-drainage variabilities. The general long-term trend shows a decrease in discharge for all rivers but in particular for the Río Grande. Graphic: VS.

The amplitude of inter-annual changes is not uniform throughout the South Coast but differs from drainage to drainage. This phenomenon, however, likely mirrors the individual extent, topography, and water storage capacity of the respective catchment areas rather than local differences in rainfall. The amount of precipitation that evaporates or is stored in soils and plants is a rather stable absolute value while the total rainfall varies considerably. As a consequence, if precipitation decreases in absolute terms the relative share that runs off into a river decreases as well. Accordingly, variations in runoff volume will be more extreme in the drainages of minor rivers with a low absolute discharge volume. From 1934-1968, the climate became drier and the mean annual runoff of all South Coast rivers dropped slightly (Figure 11, black line). In case of the Río Grande drainage (as a whole) this development is much more pronounced (red line) because its discharge volume is below the average. Drier conditions therefore affect the availability of irrigation water to a greater extent than, for example, in the Pisco valley.

Altogether, it can be assumed that 20th-century precipitation patterns were relatively variable in a multi-millennia perspective, but this has to be considered a hypothesis as long as no high-resolution data is available for the more distant past. As temperature and precipitation are two closely linked factors in the climate system, the same statement could be made for temperatures.

4.3.4 The Potential of Irrigation Agriculture

Irrigation agriculture at the valley floors is generally more productive than the rain-dependent highland farming but it is limited by the amount of cultivable land and the availability of river water. The extent of the valley floors restricts the area that is potentially irrigable and the discharge volume of the rivers determines the potentially available irrigation water. The latter is directly related to precipitation patterns in the highland catchment area. If the runoff exceeds the optimal amount needed for irrigation, the excess will just flow into the ocean and is of no productive use. On the other hand, if the water does not suffice to irrigate all of the potentially cultivable land, some fields will render no yield. The temporal distribution of the annual discharge is also crucial: if runoff is extremely high for a few weeks and then rivers fall dry, the short-time abundance is of no use during the following dry period and crops may wither before harvest. A lower total amount of water evenly apportioned throughout the growing season can hence be much more helpful.

Today, large artificial reservoirs can balance the fluctuations to a certain degree. Additionally, massive ground water tapping with the help of motor pumps plays an increasingly prominent part in water supply.⁷⁵ There is some pre-Hispanic evidence of diverse installations for the storage of water by conducting it on terraces or sediment-filled quebradas closed by a bund where it seeps into the soil.⁷⁶ Furthermore, ground water tapping had already been practiced in the SGD since Nasca times with the help of filtration galleries, the so-called *puquios* (Schreiber & Lancho Rojas 2003). Both water storage and ground water extraction nevertheless will have been of a rather small scale when compared to today's situation.

In order to get an idea of the availability of land and water in different South Coast valleys, the data published by ONERN in the 1970s (1970/1971a,b,c/1975) is most helpful, not only because it is sufficiently detailed and considers observation periods of at least two decades but also because at this time the impact of modern modifications by canal construction and terrain leveling with the help of heavy machinery and explosives was still relatively limited. In effect, this data is more suitable for projections into pre-Hispanic times than very recent one.

Figure 12 shows the mean annual discharge volume of the major South Coast rivers, the potentially cultivable land, and the relation between volume and irrigable land. The potentially irrigable land comprises the lowland valley floors, including the small portions of remaining riverine forests. Some fields had already been abandoned before 1970 due to problems of water supply or salinization. The relation between discharge volume and irrigated or potentially irrigable area may serve as an indicator for the relative vulnerability of local agriculture to droughts, though it cannot serve to determine the amount of irrigation water actually available because it does not reflect its distribution over an entire year. The figure illustrates that in the valley with the highest runoff, the Pisco valley, comparatively few land is available.⁷⁷ In Ica, in turn, where the most extended cultivable area can be found, the hydrological resources are lowest. In Acari and Yauca, the absolute area suitable for irrigation is so small that rain-fed agriculture will always have predominated, but at least the few irrigated fields available were not ever likely to suffer from water shortages, particularly in Yauca.

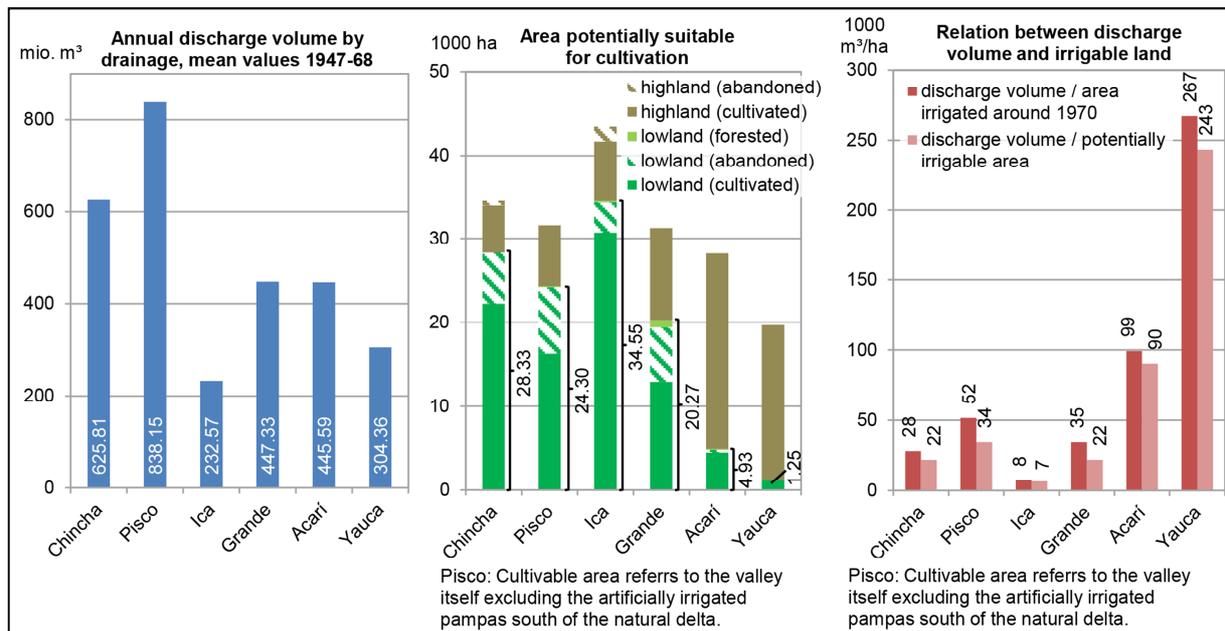


Figure 12: Comparison of South Coast valleys: Mean annual discharge volumes of rivers, calculated for the period 1947-1968, and cultivable land as around 1970 after data published by ONERN (1970/1971a,b,c/1975). Graphics: VS.

⁷⁵ Many wells are now being drilled more than 100 meters deep. In recent years, ground water extraction significantly exceeds the natural refilling capacities, resulting in a lowering of the ground water table at a dramatic pace, especially in the Ica valley, where it currently drops by more than a meter per year (Hepworth et al. 2010).

⁷⁶ E.g., the Khadin-like system at Huayurí in the Santa Cruz valley mentioned in Chapter 2.2.3 (Mächtle et al. 2009/2012).

⁷⁷ ONERN (1971c) distinguishes between the “valle viejo,” which is the Pisco valley proper, and the “Pampas de Lanchas y Santa Cruz” in the desert just south of the river delta which could not have been claimed without motor pumps. For the purpose of this study, only the “valle viejo” has been considered, as it roughly corresponds to the area which could also have been irrigated in pre-Hispanic times.

Under stable, semi-arid conditions, when the discharge volume of all rivers suffices to water all irrigable fields in the respective valleys throughout the growing season, Ica has the highest potential for irrigation agriculture, followed by Chincha, Pisco, and the Río Grande drainage (as a whole). Under dry or variable conditions, in contrast, after Yauca and Acarí, it is the Pisco valley where harvests can be expected to be most reliable (though limited in quantities), followed by the Río Grande drainage and Chincha. Ica, in turn, is now becoming the by far most precarious valley of all. This is very important to understand when regarding possible inter-drainage population shifts on the South Coast in pre-Hispanic times.

The Río Grande drainage is a special case in that it consists of eight major branches (lumping the Río Nasca with its two tributaries, the Río Aja and the Río Tierras Blancas). Each of these branches shows a very different sensitivity to water shortages as illustrated in Figure 13. While in the Río Grande valley itself the volume/irrigation area relation is comparable to that of the Acarí valley, and the Palpa, Viscas, and Ingenio branches still have values significantly higher than that for Chincha, the entire SGD is as vulnerable to dry conditions as Ica. Even the Santa Cruz valley, by far the driest branch of the NGD, still has more potential than the most productive of the southern valleys (Nasca, including Aja and Tierras Blancas). It seems therefore logical that the Nasca-era *puquios* were constructed in the SGD (Schreiber & Lancho Rojas 2003), while no such facilities are known from the NGD.

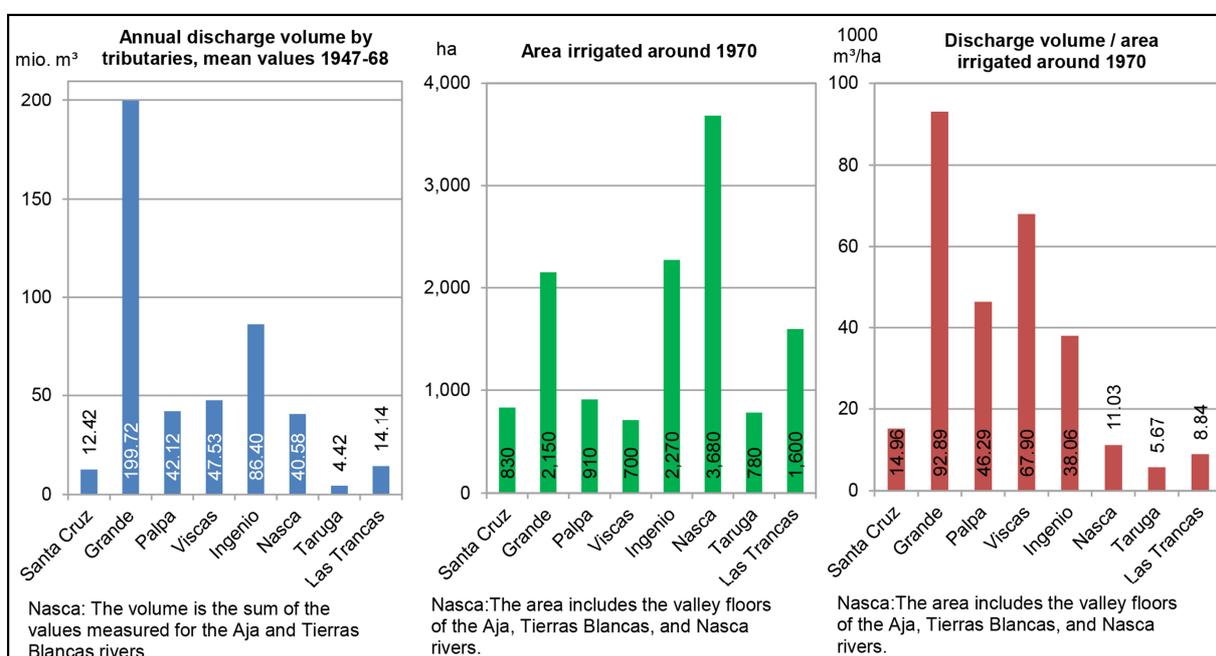


Figure 13: Comparison of the eight major valleys of the Río Grande drainage: Mean annual discharge volumes of rivers, calculated for the period 1947-1968, and irrigated land as around 1970 after data published by ONERN (1971a). Graphics: VS.

While the potential for irrigation agriculture in the Río Grande drainage as a whole takes an intermediate place in a South Coast comparison, the differences between its northern and its southern branch are enormous. While the north is among the valleys with the best water supply, the south is most vulnerable to dry conditions. Accordingly, for pre-Hispanic periods, climate related intra-drainage population shifts have to be considered possible or even likely.

4.3.5 The Agricultural Potential under Different Climatic Conditions

Each of the three basic climatic factors – precipitation, AMMTGS, and variability – changed through time causing the agricultural potential to fluctuate as well. Furthermore, rain-dependent highland farming and irrigation farming at the valley floors are affected differently by changing parameters. The average monthly minimum temperature during the growing season and local precipitation patterns restrict the potentially suitable areas for highland agriculture. Rain-fed farming is theoretically possible below the frost margin and above the *yunga-quechua* border, that is, above the ≈250 mm isohyet. In praxis, a minimum of 350-400 mm of annual precipitation is more realistic, because below this amount, the risk of crop failures in years with below-average rainfall is very high (see Chapter 4.3.1). The respective isohyet corresponds roughly to the 3000-m-isohypse. Since factors like soil quality and

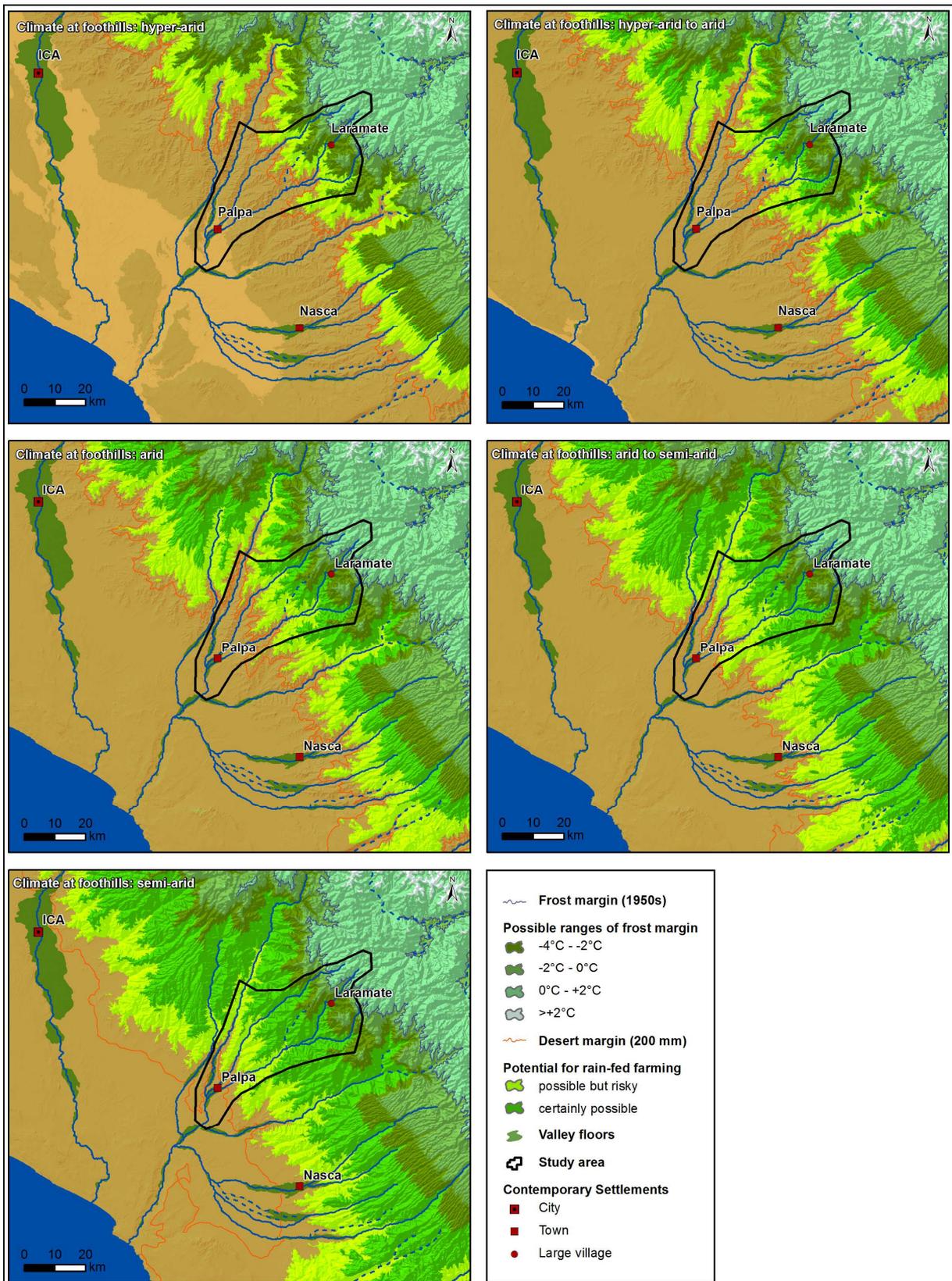
slope have to be considered as well, only a small fraction of the delimited zone will actually be cultivable. Irrigation farming, in turn, is only possible at or close to the valley floors, which are located below the frost margin even under cold conditions. The limiting factor here is the amount of river water which can be conducted to the fields. Map 8 displays changes in the extent of the potentially cultivable area under different climatic conditions. When combining the factors precipitation, AMMTGS, and general climate variability, conditions may have shifted between the following eight extreme scenarios:

- 1) *Semi-arid, warm, and stable*: These are the best conditions for farming societies. Precipitation is sufficient, regular, and reliable at altitudes down to 1500 m.a.s.l. and even lower, allowing rain-fed terrace farming all along the valley slopes. Several *quebradas*, which do not carry water today, turn into small rivers allowing irrigation in some lateral valleys. At the same time, the frost margin shifts upward to about 4200 m.a.s.l., or even higher, allowing farming in the *puna* where much more flat or only slightly inclined terrain (requiring less investment in terrace construction) is available than in the valleys. The low inter-annual variability and hence the predictability of climate minimizes losses due to extreme weather events and almost all fields will generate a satisfying harvest during most years.
- 2) *Hyper-arid, warm, and stable*: Precipitation is limited but reliable. Rain-fed farming is risky below 3000 m.a.s.l. and definitely impossible below 2300 m.a.s.l. but can be practiced at high altitudes. Only the major rivers provide sufficient irrigation water for the cultivation of the valley floors. Altogether, the potentially arable area is drastically reduced compared to scenario 1), but at least the fields still under cultivation generate a reliable harvest.
- 3) *Semi-arid, cold, and stable*: There is sufficient and reliable precipitation but the frost margin has shifted downwards to about 3000-3500 m.a.s.l. Consequently, the area which today falls within the *suni* and *puna* zones and even the more elevated parts of the *quechua* have become unsuitable for cropping due to frequent frosts. They nevertheless still provide vast and rich pasture grounds for camelid herding. At the lower reaches down to 1500 m.a.s.l., in turn, rain-fed terrace cultivation is possible, which complements the highly productive irrigation farming at the valley floors, including some smaller *quebradas*.
- 4) *Hyper-arid, cold, and stable*: Precipitation is so sparse that reliable rain-fed cultivation would only be possible above 3000 m.a.s.l., but at the same time, the frost margin at 3000-3500 m.a.s.l. only leaves small patches here and there where water suffices *and* temperatures are high enough. Additionally, irrigation farming is limited to the valley floors of the major rivers while smaller *quebradas* fall dry. Despite the drastic restrictions, conditions are at least stable and the worked fields can be expected to generate a reliable harvest.
- 5) *Semi-arid, warm, and variable*: The general conditions are similar to those in scenario 1), but there is a high risk of occasional droughts, of summer rains being too hefty, starting too late, or ending too early, and of abnormal frost events. In good years, harvests are abundant, but in bad years, they may fail almost completely. Furthermore, a series of subsequent bad years may occur. In this scenario, a sophisticated risk management including extended storage, economic diversification, and tight reciprocal exchange relations with groups in potentially unaffected, distant areas are crucial.
- 6) *Hyper-arid, warm, and variable*: Even though the high frost margin allows farming in much of the highlands in good years, this is a highly risky enterprise because years with abnormally strong frosts are frequent. In these cases, a good part of the harvest is lost. At the lower reaches, where there is no frost risk any more, insufficient, too heavy, or badly timed rainfalls have to be taken into consideration. In the worst case, frosts and unfavorable precipitation occur in the same year, reducing the agricultural output to almost nothing. Under these conditions, societies dependent on farming are extremely vulnerable because even in good years the expected surplus, which could be stored for worse times, is minimal.
- 7) *Semi-arid, cold, and variable*: This scenario is almost as critical as scenario 6). Even though precipitation generally allows thriving rain-fed and irrigation farming at the lower reaches, abnormal irregularities in rainfall patterns may, in some years, destroy the biggest part of the harvest. At altitudes close to the low frost margin, unusual frosts can occur any time. The normal production is probably a bit higher than in 6) but the risk of crop failures and hence the vulnerability of farmer societies is almost as severe.
- 8) *Hyper-arid, cold, and variable*: This is the worst scenario of all. Not only is the suitable area for agriculture as restricted as in scenario 4), but additionally, large parts of the harvests are fre-

quently destroyed by abnormally hefty or lacking precipitation and unpredictable frosts. Under these conditions, only small patches of the best land in zones of lowest risk can be farmed with ongoing success. As a consequence, population density has to be kept extremely low.

As outlined in the previous chapters the respective South Coast drainages will have been affected differently by these scenarios. Under semi-arid conditions, the valleys with the most extended floors, such as Ica, are especially favored while hyper-aridity will be most severe where the land/water relation is worst. A high AMMTGS has little impact on irrigation farming but may push the limits of rain-fed farming far into the *puna*. Drainages with small valley floors but extended *cabezadas* sections, like Acarí and Yauca, will therefore profit disproportionately. Today's conditions most likely fall into scenario 6). Although reliable data is sparse, it seems that the last two decades tended to be dryer, warmer, and less stable than the early and mid-20th century, but the difference can still be regarded as gradual. Accordingly, at least the last 100 years, but perhaps also the preceding centuries, will have tended towards scenario 6).

In Chapter 2.2.3, I summarized the current state of research on climate conditions in the study area during different sections of the past. If the reasonable assumption is correct that farmers generally tended to dwell near their fields, then the establishment of villages in certain areas and the abandonment of others elsewhere may be related to climate-induced changes in the agricultural potential. If indicators of conflict in the archaeological record correlate with worsening conditions for cultivation, such conflict may have rooted in struggles for diminishing resources. In order to assess whether major changes in settlement behavior could have been related to climate change, it is now necessary to review and classify the respective archaeological data and to discuss adequate methods for a reconstruction of basic parameters in human (pre-)history.



Map 8: Areas potentially suitable for agriculture under hyper-arid, arid, and semi-arid conditions, according to the values given in Table 1. The upper limit is determined by the AMMTGS and may have fluctuated considerably (Table 3). Maps: VS.

5 Archaeological Settlement Data - Acquisition, Classification, and Analytical Methods

The question to be addressed in this study is how much impact climate change had on cultural development and especially on settlement behavior in the northern Río Grande de Nasca drainage. In Chapter 2.2.3, climate patterns from 1500 BCE-1532 CE were reconstructed by the interpretation of published geoarchives from the study area and remote regions. Changes in settlement behavior require a profound analysis of regional settlement patterns and of the archaeological evidence in general. Dwelling sites are fine objects for study, because they are often well preserved and easy to locate. Settlement patterns can hint to a number of aspects concerning economics and socio-political circumstances, e.g., land use and social organization (Sutton & Anderson 2010:100). This approach has seen a remarkable development since Gordon Willey's pioneering Virú Valley Project (Willey 1953) and subsequent studies.⁷⁸ Many newer studies extended the classical methodological bundle by introducing computer-assisted GIS- and statistical analyses as well as new models for interpolation and prediction.⁷⁹

The analyses carried out for the present thesis build on the assumption that people presumably tried to minimize distances between home and agricultural fields. Accordingly, areas where no settlements can be found were probably not or only sparsely cultivated. If settlements were moved to defensible hilltop positions, this points to a situation of threat and conflict. The markedness and differentiation of a settlement hierarchy indicate the level of political complexity as well as the character and size of political entities. Obviously, this kind of information has to be discussed alongside other archaeological source data such as burials, iconography, non-domestic constructions, and others, in order to gain a more detailed picture of the societies of different time periods. Once a picture can be drawn for each time section, a diachronic comparison is possible which should reveal the degree of cultural change between successive epochs. If marked caesuras occur at the same time as major climatic and environmental changes reconstructed by scientists from geoarchives, the possibility of a causal relation between settlement behavior and climate fluctuations has to be discussed. In the following subchapters the methodological approaches chosen to classify and evaluate the available settlement data from the Palpa Project will be explained in detail.

5.1 Data Acquisition and Revision

The archaeological data analyzed in this thesis derives from the Palpa Project, which was carried out in the northern Río Grande de Nasca drainage (NGD) in coastal South Peru. In 1997, Markus Reindel from the German Archaeological Institute (*Deutsches Archäologisches Institut*, DAI) and Johny Isla Cuadrado from the Andean Institute for Archaeological Studies (*Instituto Andino de Estudios Arqueológicos*, INDEA) conducted first reconnaissance works around the provincial capital of Palpa in the NGD (department of Ica). In the following years, with the help of numerous students and workers, all superficially recognizable archaeological sites from all periods were registered and some were excavated on a larger scale. Until 2005, the study area at the foothills was repeatedly amplified. From 2006 on, Carolina Hohmann joined the team to conduct surveys also in the adjacent *cabezadas* zone that reaches up to the water divide. The archaeological reconnaissance ended in 2011 but excavation and conservation works at chosen sites still continue. The data from 787 sites with remains of domestic activities collected between 1997 and 2011 forms the basis for the settlement pattern analysis undertaken in the present study.⁸⁰

⁷⁸ E.g., those by Robert Adams in Mesopotamia (Adams 1965/1981), by the Southwestern Anthropological Research Group in North America (Euler & Gumerman 1978), and by William Sanders, Jeffrey Parsons, and Robert Santley in Mexico (Sanders et al. 1979). Also see Chapter 3.2.2.

⁷⁹ See Ammerman 1981 and Kowalewski 2008 for general overviews on "classical" and recent regional settlement pattern studies, respectively. Brian Roberts (1996) offers a good conceptual overview over the interpretation of the distribution of settlements in space. Applications of GIS in archaeology are described in Wescott & Brandon 2000, Conolly & Lake 2008, Esri 2009, Mehrer & Wescott 2006, and Wheatley & Gillings 2002.

⁸⁰ Although dwelling remains were found at 835 sites, in 48 cases a chronological classification was not possible. These sites, most of which are very small, were excluded from analysis.

5.1.1 Surveys and Excavations Carried Out by the Palpa Project

The Palpa Project was designed to register completely the superficially visible archaeological remains by means of surveys, but also to complement the collected information by excavations at particularly important sites regarded as representative for their respective epoch. The scale reached from the cleaning of looter holes and small test pits to the systematic excavation of areas of several hundred square meters. While most data analyzed in the present study derives from surface surveys, the more detailed information, especially with respect to construction techniques and find assemblages, was gathered during the excavations. These works will be treated in more detail in Chapter 6 when the respective settlements are presented. The most important excavations at the foothills took place at Los Molinos (Early Nasca) and La Muña (Middle Nasca) from 1998-2001 (Reindel & Isla Cuadrado 2001), at Jauranga (Middle-Late Paracas) in 2003 (Isla Cuadrado et al. 2003), at Parasmarca (Late Nasca) in 2005-2006 (Reindel 2009:455-456, Tomasto Cagigao et al. 2009), and at Pernil Alto (Archaic and Initial Periods, Early Paracas) from 2009-2011 (Reindel & Isla Cuadrado 2009). In the highlands, the sites of Cutamalla (Late Paracas) and Huayuncalla (Late Paracas/Nasca/Wari) were excavated (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013). At Collanco (Paracas), halfway between foothills and *cabezas*, scientific digging began recently in 2013.

During the first campaigns surface surveys were conducted by teams of usually two or three project members who walked the valley margins, the adjacent spurs and the stony *pampas*. From 2001 onwards, Johnny Isla continued this work in the foothills area year-round, mostly alone. From 2006-2010, Carolina Hohmann headed a survey team in the *cabezas* and *puna* areas. The fact that most sites were registered by (or under the supervision of) only these two persons assured a reasonable consistency in terms and concepts employed in the field notes.

Where archaeological remains were spotted on the surface a field form was filled in with information on the location, the geographic setting, and a description of the surface material and architectural features (Figure 20). Since tools like Google Earth[®] did not yet exist, site boundaries were drawn directly on paper copies of aerial photographs where those were available, or else the site limits were just described by words. Additionally, field sketches were drawn. Only few photos were taken as suitable digital cameras were still not available and diapositives were costly.

Re-identifying landmarks in the field or on modern Quickbird[®] satellite images resulted difficult for everyone who had not participated in the initial surveys, because many mentioned natural features such as *quebradas* are not unique. The problem grew with the time that had passed since the original recording because some man-made reference features had disappeared due to the construction of roads, canals, pens, and houses. Johnny Isla and Carolina Hohmann, who had been in charge of the original documentation of the vast majority of the sites, therefore redrew and digitized all site borders using Google Earth[®] which only recently (in 2010) had incorporated high resolution imagery of almost all of the study area. This greatly eased site localization.

When the surveys of the Palpa Project began, it soon became clear that most of the valley margins around Palpa was covered with archaeological remains. Since it would have been of little use to join large sections of a valley margin into a single site, an arbitrary separation often had to be applied for practical reasons, especially to facilitate site descriptions. Reindel and Isla in some cases decided to refer to natural landmarks like small gullies (*quebradas*) or even modern features like roads or canals which are easily identifiable boundaries but do not always correspond to the actual limits of a given archaeological occupation.

Some sites still turned out to be quite extended and had to be subdivided into sectors. The sectors may also reflect the tentative limits of occupations from different phases or of areas with different types of usage. Since these units are often overlapping, most sectors nevertheless contain remains of several categories. In these cases, the documentation sometimes gives hints like "Sector A (domestic): mostly Initial Nasca, but also some Late Intermediate Period in the southwest corner." This gives a rough idea of how much of each sector shows remains attributable to a certain occupation.

In the documentation of the Palpa Project, a site may belong to one or several of these eight functional categories:

- Public: Space connected to or inside a settlement used for administrative or ritual purposes, especially artificial platforms and "formal" regular and high quality architecture

- Domestic: Space covered by common dwellings and their immediate surroundings where remains of domestic activity like dwelling foundations, sooted potsherds and stone flakes are present
- Cemetery: Space containing any kind of funeral ranging from simple pit graves to masoned elite tombs
- Agricultural Terraces: Space in the immediate surroundings of a dwelling site covered by terraces, which were apparently used for cultivation. Terraces not connected to a site where generally not registered by the Palpa Project
- Pens: Enclosures of stacked field stones significantly more ample than dwellings and probably used for keeping llamas and alpacas
- Geoglyphs: Space covered by ground drawings of the Paracas and Nasca cultures
- Petroglyphs: Presence of painted or carved stones
- Others: Rarely observable special features which do not fit into any of the other categories, such as observation points or pre-Hispanic roads and canals

For the purpose of the present investigation, only sites containing remains which fall into the public or domestic categories have been used for statistical and spatial analyses. Contexts of all categories – particularly excavated ones – have been considered in the general discussion of cultural and socio-political features of past societies.

In the following, when referring to a specific site, the numeration of the Palpa Project with the prefix “PAP-“ will be used. Site sectors are distinguished by capital letters. PAP-93 A, for example, refers to sector A of site 93. These numbers were only provisionally assigned during fieldwork, as it was expected that some site delimitations would be altered when the survey would advance and the overall picture would become more complete. After a thorough revision of field data, final site numbers following the official Peruvian nomenclature would be assigned. After this naming system, a site is named with the prefix “PV” (*Perú Valle*) followed by the ID-number of the respective river valley and finally the site number. In 2006, these PV-numbers were assigned to all sites registered so far. Indeed, in several cases original PAP-sites were joined or split up, so that more than one PAP-number can correspond to the same PV-number while in other cases individual sectors of a PAP-site were assigned different PV-numbers. However, this step has not been repeated recently for the sites discovered since 2006, which are essentially those in the highlands. These sites still only have a PAP-number. In the present study, this issue has no relevance because the settlements do not correspond to site delimitations (see Chapter 5.2.1). Some important sites are also known by popular names often derived from a nearby village or the valley section in which they are located, e.g., Los Molinos, La Muña, Jauranga, or Pernil Alto. As these popular names are probably easier to remember for the reader than the numbers, they are usually appended in round brackets when referring to the respective sites or to settlements including parts of these sites.

5.1.2 Restructuring of the Palpa Project Database

Long-term projects, such as the Palpa Project, tend to produce large amounts of data. This is a great opportunity to get new insights, but it also bears the risk that the sheer mass of information obscures the crucial pieces that could help to find answers to specific questions. A systematic evaluation of the data requires adequate storage in a database, so that it can easily be queried, updated, checked, complemented, and grouped. Building such a database is a major challenge demanding a lot of working time for setting up the right structure and designing a suitable user interface. The one employed in the present study underwent a long evolutionary process but now offers a variety of functionalities necessary for in-depth analyses of the stored information. Furthermore, repeatedly migrating data into new structures without losses or corruption was a major challenge but an indispensable prerequisite for most of the analyses carried out later on. With these tasks completed, however, ample and manifold statistical evaluations were possible. Moreover, the database could be linked dynamically to a geographic information system (GIS) to perform the spatial analyses described later on (Chapter 5.4).

In the Palpa Project, the storage of archaeological field data into a database was practiced from the very beginning of the surveys in 1997. At this time, the software used for this purpose was the by then

most common program dBase[®], which still lacked a lot of the functionalities of today's software solutions. Text information was inserted in Spanish, and the database elements were named in Spanish too in order to facilitate the usage for Peruvian colleagues.

The first version was designed to hold a limited amount of survey data that could easily be overlooked, corrected, and updated manually. Most of the information was stored in a single table consisting predominantly of free text fields. It mostly comprised descriptions of sites and their surroundings, coordinates, absolute altitude, and approximate area. The observed types of occupations were stored in systematic Boolean fields initially representing only five categories: public (originally termed *monumental*), domestic, cemetery, geoglyphs, and others. Information about surface material was held both in a text field and in Boolean fields indicating the presence or absence of eight classes of artifacts: ceramic, textiles, stone, metal, bone, mollusks, botanic, and others. The crucial information about a tentative temporal classification based on stylistically diagnostic surface remains was originally not held in systematic fields but as free text only, because it was still not known what would be encountered in a study area where little previous investigation had taken place. Accordingly, defining fixed cultural phases in advance would have made little sense.

Some years later, Microsoft's Access[®] 2000 became available and the database was converted into the respective mdb-format. This allowed for a more comfortable data handling via user forms (Figure 14).⁸¹ By 2003, the Palpa Project still continued and several hundred sites had already been documented – many more than originally expected. The amount of data soon grew to a degree where manual revision became inefficient. Errors and inconsistencies in the information were hard to detect and searches in text fields bore the high risk of either not catching all relevant records or catching the wrong ones.

In 2005, Karsten Lambers redesigned parts of the data structure, adding to the site table Boolean fields for each possible combination of phase and occupation type to indicate its presence or absence at a site. Two types were added: Petroglyphs, which were formerly lumped with "others," and Agricultural Terraces which can be found almost exclusively in the *cabezadas*. The advantage of the new design is the easy handling via a user form with checkboxes arranged in a cross table layout (Figure 15, on the right). On the other hand, querying can be difficult. When searching for all Nasca sites, regardless of category, for example, 28 fields would have to be queried (four Nasca phases by seven types).

Despite the improvement in the data structure, the basic task of actually revising and transferring information from text fields into the systematic structure remained undone. In 2006, I was given the opportunity to use the database for my MA studies of Nasca-period settlements (Soßna 2007/2012). For this purpose, the systematization of information of sites, especially on the temporal classification, was crucial. I therefore revised all text fields of the approximately 750 records stored in the site table at that time and transferred the basic information into the systematic fields. As a result, reliable filtering by occupation type and phase was made possible. Pens were added as a new type category because they were reported in large numbers from the *cabezadas* and *puna* areas, which had been incorporated into the study area in 2006.

Since 2008, I was officially responsible for the maintenance and further development of the Palpa Project database. During the last years, its structure grew much more complex. Additional information had to be stored in separate but linked tables, for example, the information about ¹⁴C and aDNA samples. It also became evident that the combined site type/phase fields were not adequate for

Nº SITIO	Nº SITIO PV	SECTOR	SECTOR DEL VALLE	UTM_ESTE	UTM_NORTE		
78	PV66-48		El Arenal	476,06	8390,54		
ALTURA	MAPAS	FOTO_HORIZON	FOTO_SAN				
315 m.s.n.m.		1:50000, 1:10000 Naz	524-538				
TOPOGRAFIA	ENTORNO						
En la cima y laderas de dos colinas (tipo espón) que se mirando al Este, cerca al borde del valle y al Norte de PAP-77. El sitio se extiende hacia el Norte, pasando un afloramiento rocoso, donde ocupa los							
Directo a los recursos del valle.							
TIPO DE SITIO:							
MONUMENTAL	DOMESTICO	CEMENTERIO	GEOGLIFOS	TERRAZAS	S_OTROS		
Yes	Yes	Yes	No	No	No		
DESCRIPCION:							
El área del sitio es 4.5 Has. En la parte baja y Sur del sitio se encuentran grandes plataformas formadas por gruesos rellenos constructivos, algunas estructuras de planta cuadrangular construidos con muros de adobes de doble cara y amplias terrazas escalonadas. Muros de adobes molariformes y odontiformes se observan en distintas partes. En la parte Norte y Oeste, cuando empieza la pendiente, predominan las terrazas escalonadas construidas con muros de contención de cantos rodados. En toda esta parte del sitio se observan grandes y densas capas de residuos domésticos asociados a pisos y muros de							
RECOLECCION DE MATERIALES:							
CERAMICA	TEXTILES	LITICO	METALES	HUESOS	MOLUSCOS	BOTANICO	MATERIAL OTROS
Yes	Yes	Yes	No	Yes	Yes	Yes	N
FILIACION CULTURAL							
Monumental? doméstico: Ocucaje 8, Proto-Nasca?, Nasca 2, Nasca 3, Nasca 4 y Nasca 5							
Cementerio: Ocucaje 8?, Nasca 4, Nasca 5.							
CONSERVACION		CROQUIS DIBUJO		LEVANTAMIENTO			
Regular, x los huaseos		Yes					
FOTOS							
Nº DE BOLSA DEL MATERIAL							
160, 164-167, 333, 384, 603, 604, 811, 815-818, 1162, 1163, 1273, 1142							
OBSERVACION							
La definición de monumental se refiere al volumen de ocupación y a la arquitectura de adobe de evidente función pública.							
Otras referencias: G737, G738 (Browne 1932: 114).							
FECHA			NOMBRE				
12.11.1997			Johnny Isla				

Figure 14: The first form in the Palpa Project database designed in Access[®] 2000. Most information is held in text fields and only the site type and the classes of surface material are stored in Boolean fields. Graphic: VS.

⁸¹ Later on, the improved version Access[®] 2003 was used. Currently, Access[®] 2010 is employed.

Proyecto Arqueológico Nasca-Palpa: Registro de Sitios

SITIO N° PAP: 78 Sector: Sector del valle: El Arenal N° PV: PV66-48 ID_Sitio: 491 TIPO Y FILIACION ID_Sitio: 491

UBICACION Valle: Sector del valle: El Arenal
 UTM E original: 476060 UTM N original: 8390540 Altura (msnm): 315
 UTM E WGS84: 475837 UTM N WGS84: 8390161 Area (ha): 4,5000
 Mapas: 1:50000, 1:10000 N: Foto Horizon: Foto SAN: 524-538

DESCRIPCION
 Topografía: En la cima y laderas de dos colinas (tipo espolón) que se mirando al Este, cerca al borde del valle y al Norte de PAP-77. El sitio se extiende hacia el Norte, pasando un afloramiento rocoso, donde ocupa los bordes bajos y el cauce de una pequeña quebrada.
 Entorno: Directo a los recursos del valle.
 Descripción: El área del sitio es 4.5 Has. En la parte baja y Sur del sitio se encuentran grandes plataformas formadas por gruesos rellenos constructivos, algunas estructuras de planta cuadrangular construidos con muros de adobes de doble cara y amplias terrazas escalonadas. Muros de adobes molariformes y odontiformes se observan en distintas partes. En la parte Norte y Oeste, cuando empieza la pendiente, predominan las terrazas escalonadas construidas con muros de contención de cantos rodados. En toda esta parte del sitio se observan grandes y densas capas de residuos domésticos asociados a pisos y muros de diferentes épocas.

MATERIALES Metales: Otros: Otros materiales: Cerámica: Huesos: Filiación cultural: Monumental?, doméstico: Ocucaje 8, Proto-Nasca?, Nasca 2, Nasca 3, Nasca 4 y Nasca 5. Cementerio: Ocucaje 8?, Nasca 4, Nasca 5.
 Textiles: Moluscos: Cerámica: Botánico: Lítico: Filación cultural: M O N U M E N T A L D O M E S T I C O C E M E N T E R I O G E O G L I F O S P E T R O G L I F O S T E R R A Z A S A S A G R I O T R O S

CONSERVACION Regular, x los huaqueos

DOCUMENTACION Croquis: Levantamiento: Recolección de materiales:
 Fotos N°: 160, 164-167, 333, 384, 603, 604, 811, 815-818, 1162, 1163, 1273, 1274
 Observación: La definición de monumental se refiere al volumen de ocupación y a la arquitectura de adobe de evidente función pública. Fecha: 12.11.1997
 Responsable: Johnny Isla

DATOS RELACIONADOS
 Rasgos Geoglifos
 Muestras Fotos
 Dibujos de cerámica de prospección
 Dibujos de excavación
 Dibujos de cerámica de excavación

Figure 15: The improved sites user form of the Palpa Project database as in 2005 with the newly introduced Boolean fields capable to hold the combined information for site type and phase (occupations), but still not filled in. The original text data can be found in the field "filiación cultural" at the lower center of the form. Graphic: VS.

certain tasks, such as linking the database to vector data in a geographic information system (Chapter 5.4.1) and complex querying.

For this reason, a normalization of the table structure was required. New individual tables were therefore created to hold the phases and occupation types. Furthermore, an additional table was introduced that stored categories for the degree of a classification's reliability. It was now possible to differentiate between:

- phase and type certain
- phase certain / type uncertain
- phase uncertain / type certain
- phase and type uncertain

All three tables could then be linked with the site table in a many-to-many relation (n:m) via an auxiliary link table that holds only the primary keys of the linked records. For example, a site can have been occupied in various phases but also in each phase a number of sites were in use. Each of these relations corresponds to a record in the auxiliary table. Figure 16 shows the new structure of the site database with the main table termed *tbl_sit* ("tbl" for *tabla* and "sit" for *sitios*). To its left, the auxiliary table *tbl_sit_atr* links it to the type table (*tbl_tip*), the phase table (*tbl_fas*) and the reliability table (*tbl_seg*).

The migration of information from the Boolean fields to the linked table structure could be done

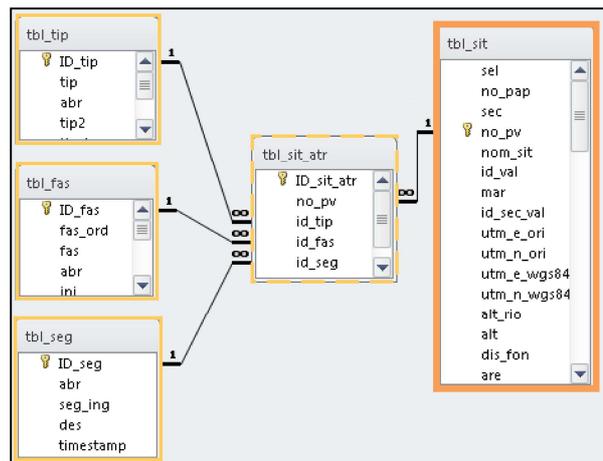


Figure 16: The current structure for the handling of information about site categories in the Palpa Project database. The site table (*tbl_sit*) is linked to the site type table (*tbl_tip*), the phase table (*tbl_fas*), and the reliability table (*tbl_seg*) via an auxiliary link table (*tbl_sit_atr*) in a many-to-many relation (n:m). Graphic: VS.

automatically with the help of a VBA⁸² function written for this purpose. As a consequence, data filtering was much easier. At the same time, maintaining the cross table layout in the user form was a challenge. The checkboxes were replaced by unbound combo-boxes, which show the degree of certainty of the classification. VBA code had to be written, which is triggered when the focus jumps to the next record. It dynamically fills the combo-boxes according to the data in the link tables referring to the currently displayed site record. When changing the value of one of the combo-boxes, it adds, deletes, or updates the corresponding record in the auxiliary link table.

Another new feature is the introduction of a site sector table (*tbl_sec*). Since many larger and more complex sites had been split up into sectors during the documentation process, the most detailed information is often available about the occupation of a particular sector. For example, Sector A could be a Middle Nasca cemetery and Sector B could show remains of an Early Nasca domestic occupation with intrusive graves from the Middle Ica phase. The site as a whole would be assigned all three occupations even though none of them spreads over its entire area. To make better use of the more fine-grained information about sectors, the sector table was created and linked as well to the phase, type, and reliability tables in a many-to-many relation. To the site table, in turn, it is related as one-to-many (1:n) because each sector belongs to only one site.

A subform on the *Sectores* tab of the site form (Figure 17) shows details about the occupations on the sector level. The example in Figure 18 displays the data of sector A of site PAP-31. On the upper right, the area percentage for each of the four occupations is given. At this site, structures of apparent domestic use from the Middle Ica phase (*Ica Medio* → IM) with traces of an older Early Nasca settlement partly overlap some large Early Nasca Geoglyphs. The sector comprises both the geoglyphs and the settlements, but none of the occupations stretches over its entire area. Below the percentage fields, the check boxes indicate why the sector is larger than the occupation in question. In this case, they refer to the active (highlighted) Middle Ica domestic occupation. Since parts of the sector were not used for dwelling (the geoglyphs) and others were only occupied during the Early Nasca phase, the two corresponding checkboxes are marked.⁸³ In other cases, the percentage is less than 100%

The screenshot shows a complex data entry form. At the top, it's titled 'Proyecto Arqueológico Nasca-Palpa: Registro de Sitios'. There are navigation buttons and a 'Saltar a registro' field. The main form is divided into several sections: 'SITIO' with fields for 'Nº PAP:', 'Sector:', and 'Otras referencias:'. Below that, 'Registrado por:' and 'el día:'. A 'UBICACION' section includes a map and fields for 'UTM WGS84:', 'Altura (msnm):', 'Área (ha):', 'Valle:', 'Margen:', and 'Sector del valle:'. The 'DESCRIPCION' section has 'Año(s) de excav.:', 'Grado de inv.:', and 'Estado de conservación:'. The 'Sectores' tab is active, showing a table with columns for phase/site type and reliability. The table lists various archaeological phases like 'Ica Tardío / Ica Medio', 'Wari Tardío / Ica Temprano', 'Wari Temprano (Loro, Chakipampal)', 'Wari (no especificado)', 'Nasca Tardío (Nasca 6, 7)', 'Nasca Medio (Nasca 4, 5)', 'Nasca Temprano (Nasca 2, 3)', 'Nasca Inicial (Ocucaje 10, Nasca 1)', 'Nasca (no especificado)', 'Paracas Tardío (Ocucaje 8, 9)', 'Paracas Medio (Ocucaje 5, 6, 7)', 'Paracas Temprano (Ocucaje 3, 4)', and 'Paracas (no especificado)'. The table also includes 'Periodo Inicial' and 'Periodo Arcaico'. The reliability of the classification is indicated by values like 'fas?/tp?' or 'fas?/tp!' in the 'OTROS' column.

Figure 17: The current user form for the registration of sites. The phase/site type checkboxes have been replaced by unbound combo boxes (bottom right quarter) that are filled via VBA code querying the auxiliary link table. The information is not limited to present/absent but the reliability of the phase/site type classification is indicated. Graphic: VS.

⁸² Visual Basic for Applications: Microsoft’s programming language designed for the Office package.

⁸³ The three checkboxes read:

- Part of the sector is non-domestic
- Very few diagnostic material
- Part of the sector dates to another phase

Tipo y filiación		Sectores		Ubicación, mapas/fotos aéreas		Fotos y dibujos		Hallazgos/materiales	
Sector	Coordenadas UTM	Area	Altura	ID	Porcentaje del area total del sector que cubre la ocupación				
31 A	481149 E / 8395817 N	1,14 ha	443 m.s.n.m.	385	Doméstico?: IM	30 %			
31 B	481143 E / 8395651 N	0,46 ha	415 m.s.n.m.	386	Doméstico?: NTe	40 %			
31 C	481094 E / 8395611 N	0,24 ha	412 m.s.n.m.	387	Doméstico?: NI?	40 %			
					Geoglifos: NTe	50 %			
menos que 100% por: <input checked="" type="checkbox"/> parte del sector no es habitacional <input type="checkbox"/> muy poco material diagnóstico <input checked="" type="checkbox"/> parte del sector data a otra(s) fase(s)									
Comentario: <input type="text"/>									
Presencia de la(s) fase(s): <input type="text"/>									
La categoría "otros" se refiere a: <input type="text"/>									
		PUBLICO	DOMES.	CON. FUN.	GEOGL.	PETROGL.	TER. AGRI.	CORRALES	OTROS
<i>no determinado</i>		---	---	---	---	---	---	---	---
Horizonte Tardío		---	---	---	---	---	---	---	---
Intermedio Tardío		---	fas! /tip?	---	---	---	---	---	---
Horizonte Medio III		---	---	---	---	---	---	---	---
Horizonte Medio II		---	---	---	---	---	---	---	---
Horizonte Medio I (Loro)		---	---	---	---	---	---	---	---
<i>Horizonte Medio</i>		---	---	---	---	---	---	---	---
Nasca Tardío (Nasca 6, 7)		---	---	---	---	---	---	---	---
Nasca Medio (Nasca 4, 5)		---	---	---	---	---	---	---	---
Nasca Temprano (Nasca 2, 3)		---	fas! /tip!	---	fas! /tip!	---	---	---	---
Nasca Inicial (Ocucaje 10, Nasca 1)		---	fas? /tip?	---	---	---	---	---	---
<i>Nasca</i>		---	---	---	---	---	---	---	---
Paracas Tardío (Ocucaje 8, 9)		---	---	---	---	---	---	---	---
Paracas Medio (Ocucaje 5, 6, 7)		---	---	---	---	---	---	---	---
Paracas Temprano (Ocucaje 3, 4)		---	---	---	---	---	---	---	---
<i>Paracas</i>		---	---	---	---	---	---	---	---
Período Inicial		---	---	---	---	---	---	---	---
Período Arcaico		---	---	---	---	---	---	---	---

Figure 18: The sector tab of the site user form showing details about the occupations. The combo fields of the cross table indicate the classification of the currently active sector A of site PAP-31. On the upper right, for each occupation the percentage it covers of the sector area is given. Indicated below are the reasons why it has been assumed that an occupation covered less than 100% of the sector area. Graphic: VS.

because the diagnostic surface material is so scarce that the density and intensity of the occupation seem to have been very low and thus should have less weight than an occupation with a similar extent but with plenty of surface material indicating intensive, long-term activity. Obviously, the percentage numbers are only very rough estimates but still they help to make later analyses based on settlement area significantly more accurate than just considering sector areas as a whole.

Finally, one further table was introduced for the storage of data about architectural features, in particular the number and size of pens and dwelling remains, which are still observable at a number of sites. The quality of this information is very heterogeneous and depends on site preservation and the visibility of structures on the surface.

5.1.3 Complementary Surveys

Despite the effort made to build up an efficient database, even the most sophisticated software tools cannot generate results better in quality than the processed raw data itself. Much labor therefore had to be invested in data revision. Luckily, the documentation of the Palpa Project is relatively detailed

and extensive. Accordingly, reliable results can be expected from its analyses. It nevertheless seemed appropriate to revisit the sites that I had not personally seen before in order to check the reliability of the provisional classification based on field documentation (Figure 19). The following points argued for a revision in the field:

- For many sites only few or no photos existed, which made it hard to get a good impression of their nature. This is especially true for those documented before 2003, when digital cameras were not yet employed in the Palpa Project. Instead, diapositives were taken but, as these were costly, they were limited to a few shots of representative features.
- Sometimes special features are mentioned but poorly described in the documentation. In these cases it was desirable to identify them in the field.
- The level of detail in the descriptions can vary significantly because some sites were visited under tight schedule restriction at the end of a campaign and were documented more superficially than others. The degree of individual field experience of the person writing down the field notes also had some impact.
- As site descriptions necessarily involve subjective appraisals, some sites that in fact are very similar were depicted with diverging terms and foci by different project members. A comparison of the documentation and the actual situation in the field was therefore important to assure that sites with comparable characteristics were classified the same way.
- Some regions seemed to be free of archaeological sites. Given the large extent of the study area it was very possible that these sections had not yet been surveyed completely. A check for sites that perhaps had been overlooked was therefore necessary to complete the data.

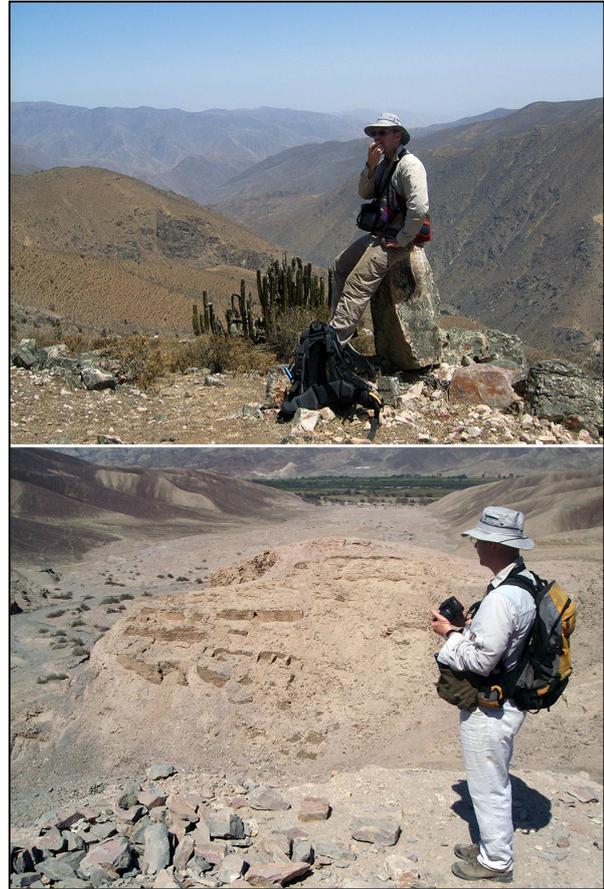


Figure 19: Revisiting sites in the highlands and at the foothills. Photos: Carolina Hohmann.

This field work was undertaken between September and November 2010 and during the same months of 2011. During these six months in total, almost 300 sites were visited. Most of them had domestic occupations and covered more than 1.5 ha or contained special architectural features. It sometimes turned out that sites were larger than originally documented, which led to a correction of their area while others appeared either more or less important than the documentation suggested. In most cases, however, the original documentation was found to be sufficiently precise. While almost the entire study area seems to have been surveyed exhaustively, five new sites were registered that lie within the study area but had not yet been visited by the Palpa Project.

Proyecto Arqueológico PALPA		Número de Catálogo de sitios	
Ficha de registro de sitios		72	
Nombres	Nombre del sitio: Otros nombres: <i>NO</i>		
Ubicación	Coordenadas UTM: <i>476, 600 E 8'391, 680 N</i> / Altura: <i>300 msnm.</i> / Mapas: <i>Nazca - Palpa 64, Hoja 18</i> Fotografías aéreas: HOR # <i>P3-7 = no se ve</i> SAN # <i>175-70 : 2898</i> Área = <i>0.480 has</i>		
Topografía	<i>Al borde del valle, sobre una suave pendiente y mirando al valle (al SE). Se ubica al Oeste de 71 (a ± 70 mts.).</i>		
Entorno y acceso a recursos	<i>Directo.</i>		
Tipo de sitio	Monumental	Doméstico	Cementerio
		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Geoglifos	Terrazas agrícolas	Otros
Descripción:	<p><i>Corresponde a un sitio con ocupación doméstica que presenta construcciones de cautos rodados en forma de terrazas escalonadas que siguen la pendiente del terreno. Solo en algunos perfiles de huacra se observan estos muros, los cuales evidentemente sirven de contención.</i></p> <p><i>La deposición de capas de basura y material orgánico es densa pero no tanto como en el sitio 71.</i></p> <p><i>El sitio fue reutilizado como cementerio en los fases Nazca 5 y 6, hay pocos tumbos Nazca 3. Las tumbas son simples en forma de pozos.</i></p>		
Pasa a la siguiente página			
Materiales de superficie	Cerámica	Textiles	Lítico
	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
	Huesos	Moluscos	Botánico
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	<i>Hay regular cantidad de fragmentos. Grandes ollas blancas usadas como urnas para entierros.</i>		
	<i>- Lítico: Un batán y un picuro de piedra.</i>		
	<i>- Diversos vegetales: Ají de maíz. Valros de choro.</i>		
Filiación cultural	<i>Ocupación doméstica: Nazca 1 (Proto-Nasca).</i> <i>Tumbas intrusivas: Nazca 5 y 6.</i>		
Estado de conservación	<i>Regular a malo. Severamente huacraado.</i>		
Documentación	Croquis	Dibujo #	Levantamiento topográfico #
	<input checked="" type="checkbox"/>		
	Fotos rollo #		Colección de materiales #
Observaciones y otros	<i>El límite superior del sitio está definido x su canal moderno en uso.</i>		
Fecha	Nombre		
<i>10-11-97</i>	<i>Johngela (ML y ST.)</i>		

Figure 20: Field form used by the members of the Palpa Projects for the registration of archaeological sites.

5.2 Classification of Settlements

The planned analyses required a threefold classification of the settlement data into chronological, quantitative, and qualitative categories. The first indicates the cultural phase during which a settlement existed, the second its population size, and the third its functional aspects and status, namely, its position in a settlement hierarchy. Since the assignment to a phase is often tentative it is necessary to differentiate between reliable and uncertain temporal classification. Similarly, the domestic character of an occupation is sometimes unclear, especially when a site was occupied for a long time and used for different purposes. Phase and domestic character are regarded as reliable for the entire settlement if they are determined with certainty for at least one of the site sectors it comprises. Accordingly, apart from the assignment of a settlement to a phase, a size, and a status class, the reliability of the chronological placement and the functional classification has to be indicated. By combining all categories, vast statistical evaluations and spatial analyses can be carried out, which will be described in Chapters 5.3 and 5.4.

5.2.1 What is a Settlement?

The results of a settlement pattern analysis will tend to be equivocal if the term *settlement* is not defined clearly. A settlement is generally understood as a place where people dwell. As Willey (Willey 1953:6) pointed out, the inhabitants of a village may have had a strict idea about the exact area it occupied and how it was related to other settlements, but this kind of information is very difficult to reconstruct archaeologically. Accordingly, in the contexts of archaeological studies, the term *settlement* actually refers to an analytical unit and as such, it should be defined and distinguished from other technical terms, especially from that of a *site*. Surprisingly, this has not been done in any settlement pattern study known to me. I will therefore use my own definition:

A settlement is an analytical unit which refers to an approximately spatially consistent area used during a single phase for dwelling and for related domestic activities. Overlapping domestic occupations from different phases are regarded individually: one settlement is defined for each of the corresponding time sections, even though they may have incorporated, partly or completely, the same space.

In turn, *site* is a technical unit which may contain several adjacent or overlapping areas with evidence of different types of activity during different phases, e.g., dwellings from Phase A re-used as a graveyard in Phase B. Where site density is high, site limits may be drawn arbitrarily as an extended occupation of one phase may continue into a neighboring site while that of another phase may not. For this reason a settlement can incorporate several neighboring sites or site sectors, partly or completely. In other cases, it may comprise a single site or site sector or even only part of it. In the example in Figure 21, site 1 includes areas with remains of domestic activity from phases A and B as well as graves from phases A and C. The neighboring site 2, in turn, was exclusively used for domestic purposes in phase B. This would translate into two settlements: one joining the contemporaneous dwelling zones from phase B at site 1 and site 2 and a second one comprising the area used domestically during phase A at site 1. As the remains of phase C at site 1 derive from non-domestic activities (burials), no settlement is defined for this phase.

Whether areas of neighboring sites used contemporaneously for domestic activities are approximately spatially consistent has to be judged discretely for every individual case. As an orientation, contemporaneous domestically used zones are generally regarded as spatially consistent if their borders, where they are closest, are within 150 m. If this is true they were generally joined into a single settlement. The joining was omitted, however, if there were clear natural obstacles between these borders, such as extremely steep slopes. Gaps wider than 150 m were accepted if old aerial photographs show archaeological features which had been razed in recent decades to expand farmland or which are now covered by

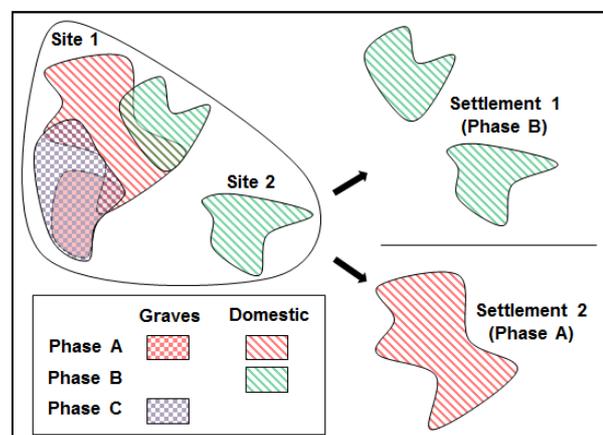


Figure 21: Schematic sketch illustrating the concept of settlement. Graphic: VS.

modern villages. In these cases what today appears to be a wide gap may once have formed part of a continuous settlement.

According to this definition, 1042 settlements were extracted from the archaeological data gathered by the Palpa Project and each one was given a unique ID-number. In the following, this number will be used with the prefix "S-." When referring to a settlement I will generally indicate the popular name or the PAP-number of the most important site sector(s) forming part of it. For example, "S-36 (Los Molinos)" refers to the Early Nasca settlement with the ID 36 incorporating the sites PAP-92 and PAP-93 (Los Molinos). A complete list of settlement and site numbers including the popular names can be found in the "Catalogs" folder on Supplement DVD 1.

5.2.2 Chronological Classification

The chronological classification of the material is an obvious prerequisite for a diachronic comparison of settlement patterns. Since the broad chronological framework commonly used in Andean archaeology has already been outlined in Chapter 3.2.1, this chapter concentrates on the subdivision of periods into phases and the numeric dating of their temporal limits.

Without any pre-colonial written records available, chronological succession has to be reconstructed on the basis of material remains alone. Under this condition, a chronological framework is ideally based on three components:

- 1) stylistically distinguishable material, especially ceramic sherds, derived from
- 2) scientifically excavated, undisturbed contexts with a well-recognizable stratigraphy plus
- 3) reliable numeric dates of individual features and layers

Regrettably, most chronologies developed for the Central Andes lack at least one of these components: radiocarbon datings are often too few and of doubtful reliability, particularly those from the 1950s to the 1970s due to still underdeveloped methods and technology. The material used to establish style chronologies in many cases originates almost exclusively from burial contexts with few or no stratigraphic information. Material derived from well-documented excavations, in turn, is still waiting in the deposits for a thorough style analysis. Luckily the Palpa Project focused on this problem right from the beginning and established a reliable chronology of ceramic styles backed by stratigraphic analyses and numerous ^{14}C datings (Unkel 2006/2012). There nevertheless still are some gaps to be filled in the future.

Only for some sites, extended stratigraphic information from large-scale excavations combined with radiocarbon measurements is available, allowing a chronological classification of contexts by direct, numeric dating. In most cases the chronological classification is based on ceramic sherds showing features attributable to a known ceramic style. These sherds may have been found on the surface of a site or in test pits. In case of surface finds the difficulty lies in identifying functionally different contexts. Sometimes tombs had been dug into an earlier settlement and were looted in recent times. In these cases, it is often difficult to distinguish between sherds originating from domestic layers and those that belong to pots buried with the mummies as grave offerings. These pots, if too crude, damaged, or otherwise of little value on the black market, were often smashed by the looters and left at the site. The degree of accuracy in the chronological classification further depends on the diagnostic quality of the sherds. In the best case, the sherds can clearly be assigned to a ceramic style but sometimes they are too crude, too few, or too poorly preserved. In the worst case, no pieces diagnostic in any way were found.

In these cases, other indicators can help to assign archaeological remains to a certain chronological section, particularly architecture (Menzel 1971:140-148). During the Nasca Period, important structures were mostly built with *adobes* whose typical form and size changed over time. It is generally possible to distinguish an Initial Nasca mud brick from one made in the Middle Nasca phase, though Silverman (2002:146) seems to disagree. Size and layout of buildings can also be diagnostic. Stone built D-shaped structures, for example, are typical for the Wari people (Middle Horizon), who used this layout for ritual buildings (McEwan & Williams 2012:72-74). The finely masoned stones of high-status Inca architecture are very characteristic too, as are the *adobes* imitating such stones (Figure 22).

5.2.2.1. Relative Chronology of the Ica and Río Grande Drainages

The master sequence that John Rowe meant to serve as an absolute timescale to correlate chronologies throughout the Central Andes was worked out for the Ica valley. Although its validity for distant regions is limited, it is surely applicable in the neighboring Río Grande drainage. The broad framework of periods and its evolution has already been presented in Chapter 3.2.1. In addition, Rowe and his students Dorothy Menzel and Lawrence Dawson also proposed a fine-grained division into phases (“epochs”) based on the seriation of decorated ceramic vessels. This research was carried out at the University of California at Berkeley, which is why their sequence is also known as the “Berkeley Sequence”. Rowe, Menzel, and Dawson subdivided their Early Horizon (EH) into ten epochs, their Early Intermediate Period (EIP) into nine, their Middle Horizon (MH) into four and their Late Intermediate Period (LIP) into ten. Each of these epochs is defined by a corresponding ceramic style present in the Ica valley.

Since the ceramic remains that can be found in the Río Grande drainage are very similar to those in Ica, the Berkeley Sequence was (and still is) used as a reference by researchers working in both regions. With fieldwork proceeding, it turned out that not all styles were clearly identifiable in sherd samples from surveys and excavations while others had a very limited spatial distribution. Some may have been in use simultaneously for some time and thus do not indicate a strict chronological succession.⁸⁴

In many recent works about the prehistoric Río Grande drainage, broader subdivisions of periods were preferred. This allows assigning several ceramic styles to a single phase to obtain chronological units that are roughly successive rather than temporally overlapping. In the present study, the time span of the development of local cultures is subdivided into the following phases:

- Initial Period: no subdivision
- Paracas (EH): Early, Middle, and Late Paracas
- Nasca (EIP): Initial, Early, Middle, and Late Nasca
- Wari (MH): Early, Middle, and Late Wari
- Ica (LIP and LH): Early Ica, Middle Ica, and Late Ica & Inca

This scheme largely follows the one used by the Palpa Project, which had been checked by stratigraphic analysis based on controlled excavations on sites from different phases. An overview of these works is given in Reindel 2009 and Reindel & Isla Cuadrado et al. 2010. The pottery from the Initial Period occupation of Pernil Alto (Reindel & Isla Cuadrado 2006) was analyzed by Markus Reindel, Johny Isla, and Uta Karrer (Karrer 2009, Reindel & Isla Cuadrado



Figure 22: Aside from diagnostic ceramic sherds, architectural features can also bear chronological information. Above: Middle Nasca walls at PAP-79 (La Muña) built with irregular, conical adobes. Middle: A strictly cuboid mud brick from an incaic wall at PAP-425. Below: A well preserved D-shaped structure at PAP-830 (Pacapacari). This layout is typical for ritual buildings of the Wari culture. Photos: VS.

⁸⁴ In his critical revision of the Ocucaje (Paracas) sequence and its comparison with material from the Chincha and Pisco valleys, Dwight Wallace (1984) already pointed to this problem. He also rightly critiqued that Menzel, Rowe, and Dawson did not clearly indicate their criteria for their qualitative weighing of certain design traits.

2009:273-277), but no stratigraphic and chronological analysis has yet been carried out. Accordingly, the present state of research does not allow a subdivision of the Initial Period.

The 10-phase Paracas (Ocucaje) sequence worked out by Menzel, Rowe and Dawson and published in some detail (Menzel et al. 1964), in turn, is too fine-grained. Ocucaje 1 and 2 are poorly defined (only on the bases of a few vessels) and scholars widely agree that they do not have any chronological significance. Consequently, the sequence should actually start with Ocucaje 3 (cf. Silverman 1991:377-378). The existence of phases 5-7 was contested by Sarah Massey (1986), but during excavations by the Palpa Project at the site of Jauranga they were confirmed in stratigraphic contexts (Isla Cuadrado et al. 2003, Isla Cuadrado 2010). Angelika Wetter (2005) studied Middle and Late Paracas sherds from Jauranga (Reindel & Isla Cuadrado 2006) stating that the styles Ocucaje 6 and 7 as defined by Menzel, Rowe, and Dawson (1964) are actually contemporaneous and that Helaine Silverman's Tajo style actually constitutes the domestic ware of the Late Paracas phase rather than an independent local style. The Palpa Project groups the styles Ocucaje 3 and 4 into Early Paracas, Ocucaje 5, 6, and 7 into Middle Paracas, and Ocucaje 8 and 9 into Late Paracas. Figure 23 compares the cultures, phases, and ceramic styles of the Berkeley Sequence and its predecessors to the chronological system employed in the present study.

Dawson's work on a 9-phase Nasca sequence has never been fully published, but outlines and excerpts can be found in Rowe 1960/1961 and several other publications.⁸⁵ Niels Hecht (2009/2010) carefully compared Dawson's sequence with material derived from excavations at the sites of Estaquera (Initial Nasca), Los Molinos (Early Nasca), La Muña (Middle Nasca), and Parasmarca (Late Nasca). He states that the styles Nasca 1, 3, 5, and 7 of the Berkeley sequence are dominant and representative for a phase while Nasca 2, 4, and 6 represent short-term and only locally important transitional styles. These were essentially in simultaneous use with one of the principal styles. Since Nasca 1 is largely contemporaneous to Ocucaje 10, the two styles are subsumed in the phase Initial Nasca. Nasca 2 and 3 belong to the Early and Nasca 4 and 5 to the Middle Nasca phase. Nasca 6 and 7, finally, are grouped into Late Nasca. In archaeological contexts Nasca 7 is also frequently associated with the Middle Horizon styles Nasca 8 (Loro) and Nasca 9/Chakipampa.

A revision of Menzel's (1964) 4-phase Middle Horizon sequence by comparison with evidence from the NGD is still pending, but material is now available from excavations at the sites of Lambrasniyoc (PAP-949), Huayuncalla (PAP-814), Los Molinos (PAP-93), Huaraco (PAP-180), and Hanaq Pacha (PAP-733). Dawson's Nasca 8 (Loro) and Nasca 9/Chakipampa seem to be widely contemporaneous. While Loro represents a local style, Chakipampa is a design developed in the Ayacucho area.⁸⁶ Both styles were joined into the Early Wari phase. Another contemporaneous Ayacucho style called Robles Moqo had been found at the site of Pacheco in the SGD but is generally very rare in the Río Grande drainage and virtually absent in the study area. The Middle Wari phase is associated with the Atarco style, a local variant of the Ayacucho Viñaque style. Atarco sherds have only been found at 12 settlements in the study area. In only one case evidence for a preceding Early Wari domestic occupation at the same place was found.

It is important to note that to date no Late Wari or Early Ica site has been identified anywhere in the NGD. This lapse of time is therefore referred to as "hiatus" in the present study. Interestingly, there seems to be some Late Wari evidence from the SGD and from Ica (Lyon 1966, Menzel 1964).⁸⁷ Great care should be taken with Menzel's definitions of the Soisongo (MH3) and Nasca Epigonal (MH4) styles, first, because very few of her material derives from well-documented scientifically excavated contexts and, second, because her main criteria for the distinction of the two is just an apparently less careful execution of the vessels: "The Ica and Nasca Valley styles of [Middle Horizon] Phase 4 are simplified and reduced derivatives of the respective Phase 3 styles and contain no new elements" (Menzel 1964:65). This does not necessarily indicate a temporal difference. It could also hint to status differences, especially in case of grave offerings. Therefore, in the present study, both styles have been merged into the Late Wari phase. Since no evidence of this phase was found in the NGD, this has no impact on the analysis.

⁸⁵ See Hecht 2010:28 for an overview.

⁸⁶ Menzel states that Nasca 9 and Chakipampa are similar but not identical and that some motifs and decor elements can only be found either at the coast or in the Ayacucho region. The differences, however, are minor and can usually only be distinguished on well preserved complete vessels, but not on small fragments. Though it is well possible that these vessels were also produced locally in the Grande drainage, perhaps by immigrated potters, the style itself was clearly developed in Ayacucho. In this study, I will not differentiate between Nasca 9 and Chakipampa.

⁸⁷ Menzel named the Nasca variant "Soisongo" and the Ica variant "Pinilla."

Uhle 1913	Kroeber / Strong / Gayton 1924-1927		Rowe / Menzel / Dawson 1952-1976			Palpa Project	Cultures
			Periods	Epochs	Styles	Phases	
Inca	Late Ica II	Inca	Colonial		Ica 10 / Colonial	Colonial	Colonial
Younger Ica Culture		Middle Ica II	Late Ica I	Late Horizon	HT	Ica 9 / Inca	Late Ica / Inca
Older Ica Culture	Middle Ica I			Late Intermediate Period	LIP 8		Ica 8
		LIP 7			Ica 7		
		LIP 6			Ica 6		
		LIP 5			Ica 5		
LIP 4		Ica 4					
LIP 3		Ica 3					
LIP 2		Ica 2					
Epigonal	Epigonal (Early Ica)		LIP 1		Ica 1	Early Ica	Hiatus
Tiahuanaco	Tiahuanaco	Middle Horizon	MH 4		Epigonal Ica / Nasca	Late Wari	
			MH 3		Soisongo	Middle Wari	
			MH 2		Atarco		
Proto Nazca	Nazca Y	Early Intermediate Period	MH 1		Nasca 9 (Chakipampa)	Early Wari	Wari / Nasca
	Nazca B		EIP 8		Nasca 8 (Loro)	Late Nasca	
	Nazca X		EIP 7		Nasca 7		
			Nazca A	EIP 6		Nasca 6	
	EIP 5				Nasca 5		
	EIP 4				Nasca 4		
	EIP 3				Nasca 3		
				EIP 2		Nasca 2	Early Nasca
		EIP 1		Nasca 1	Inicial Nasca		
		Early Horizon	EH 10		Ocucaje 10	Late Paracas	
			EH 9		Ocucaje 9		
			EH 8		Ocucaje 8	Middle Paracas	
			EH 7		Ocucaje 7		
			EH 6		Ocucaje 6		
			EH 5		Ocucaje 5	Early Paracas	
			EH 4		Ocucaje 4		
			EH 3		Ocucaje 3		
			EH 2		Ocucaje 2		
		EH 1		Ocucaje 1			
		Initial Period		Consuelo/Erizo	Initial Period	(Not defined)	
		Preceramic		Casavilca	Archaic Period	(Not defined)	

Figure 23: Comparison of the relative chronology of the Berkeley sequence and its predecessors with the sequence employed in the present study. The table is based on the one published in Reindel et al. 2010, but shows some differences concerning the later phases. The Inca phase has been joined with Late Ica. Middle Ica comprises every site with Ica style ceramics if there is no evidence of incaic sherds or architecture. Early Ica and Late Wari sites have yet not been identified in the NGD. The Initial and the Archaic Period cannot be subdivided into phases at the current state of research and no cultures have been defined, so far. Graphic: VS after Reindel et al. 2010, p. 256.

In the NGD, most Wari sites show very few diagnostic ceramics on the surface, especially in the highlands. Consequently, almost half of all settlements could not be assigned to a particular phase but only to the period in general. Those that could be classified reliably all contained sherds of the Early or Middle Wari phases. Therefore, it seems probable that the sites that could only be assigned to the period in general also date to either Early or Middle Wari, but not to Late Wari. In order to avoid analytical errors by using temporal subdivisions with unclear delimitations, all Wari time settlements were joined and treated as from a single phase (Early-Middle Wari) in all further analyses.

Menzel’s sequence for the Late Intermediate Period is problematic. Not only had it never been published completely but also the chronological order of her styles was not reflected in excavated stratified contexts (Reindel & Isla Cuadrado et al. 2010). Of her 10 phases, phase 1 was described by

Patricia Lyon (Lyon 1966) and phases 6 to 10 by Menzel herself (Menzel 1976). The definition of phases 2 to 5 remains unpublished. The LIP ceramic material from the Río Grande drainage shares similarities to that from Ica but also shows some traits of local origin (Conlee 2000). As the focus of the present work is not on style analyses, I prefer to refer to all LIP styles in the Ica and Río Grande drainages as “Ica style” to avoid confusion caused by the use of a localized terminology. Ethnically, the people inhabiting the foothills section of the Río Grande drainage will be referred to as “Nanasca,” the name used in early colonial documents. The *cabezadas* were occupied by the Rucanas.

Of the Ica 1 style, which would correspond to an Early Ica phase, no sherds could be identified in the NGD and the later Ica style material encountered in the field does not allow a clear assignment to Menzel’s styles. The Ica style pottery from the site of Chillo (PAP-396), occupied roughly between 1200 and 1400 CE, was analyzed by Heike Otten (2009, Reindel & Isla Cuadrado et al. 2010), who observed no major stylistic changes that would allow a chronological subdivision of the material. Excavations at a Late Ica or Inca site were not undertaken so far by the Palpa Project, but Christina Conlee’s (2000) work at the site of Pajonal Alto in the SGD (occupied from 1350-1550 CE) showed that the Ica style had apparently also not changed much during the later part of the LIP and the Late Horizon. Most vessel forms and decors were found in all corresponding layers and are comparable to the assemblages from Chillo. As a consequence, the only possible differentiation is an indirect one: sherds mixed with Inca-style pottery probably correspond to Menzel’s Ica 8 or 9, while all others, if not derived from numerically dated contexts, could always be assigned to any of the styles from Ica 2 to Ica 9 because a stylistic difference is not clearly recognizable. Due to these difficulties, the entire LIP and the Late Horizon had to be treated as a single phase which I shall refer to as Middle-Late Ica & Inca.

Employing the presented chronological classification, 14 settlements were assigned to the Initial Period, 20 to Early Paracas, 64 to Middle Paracas, 165 to Late Paracas, 149 to Initial Nasca, 135 to Early Nasca, 150 to Middle Nasca, 69 to Late Nasca, 68 to Early-Middle Wari, and 188 to Middle-Late Ica & Inca (Figure 24). Another 20 settlements could be classified only broadly as dating to a certain period but not to a specific phase. These were excluded from statistical calculations.⁸⁸

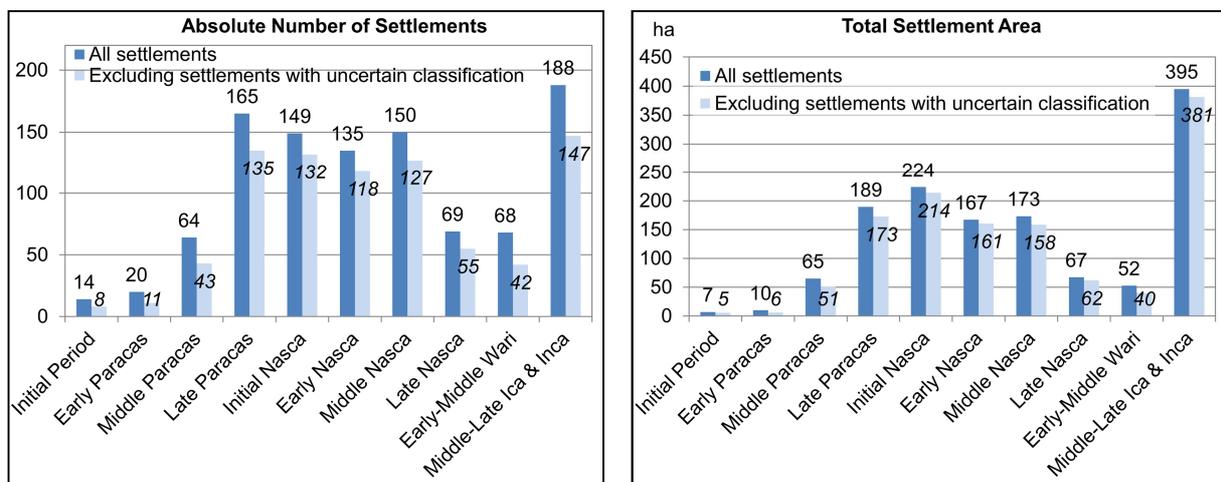


Figure 24: Number and total area of settlements assigned to each of the ten phases forming the basic chronological units. Graphics: VS.

5.2.2.2. Numeric Chronology in the Ica and Río Grande Drainages

Around 1960, John Rowe intended to date the sections of his master sequence numerically with the help of the recently developed radiocarbon dating method (Rowe 1965). The 24 samples from the South Coast (mainly from the Ica and Río Grande drainages) taken for that purpose originated predominantly from mummies and burial offerings. Rowe observed an apparent offset between a set of samples taken between 1955 and 1957 which he called the *short scale pattern* and a second one

⁸⁸ All charts shown in this chapter as well as additional diagrams not included in the present document can be found as image files in the “Charts” folder on Supplement DVD 1.

collected between 1962 and 1964, referred to as *long scale pattern*. Based on these datings, he estimated two different numeric ages for his periods.

At that time, the ^{14}C method was still inaccurate compared to today's standards. The errors indicated by the laboratories for Rowe's samples range from 52 to 214 (!) years. Apart from this error margin due to technical limitations of measurement precision, the need for calibration to deal with fluctuations in ^{14}C concentrations in the atmosphere was just being discovered.⁸⁹ Even if an up-to-date calibration is applied to Rowe's samples, the age range still comprises several centuries and therefore is too inaccurate to determine the boundaries of periods, let alone phases. Given the low number of samples, the technical limitations of the dating method as around 1960, and the lack of calibration, Rowe's numeric chronology surely cannot be considered state of the art. In the following decades, hundreds of samples have been measured from all over Peru including more than 200 from the Peruvian South Coast (Ziółkowski et al. 1994). Nevertheless, as Peter Siegle (2007) pointed out, only few of them are both accurately dated and derived from published archaeological contexts, which would allow associating the sample with a certain ceramic style.

In short, no new comprehensive effort had been undertaken to revise the numeric dates of the entire Berkeley Sequence based on samples from controlled excavations and from layers with a clear stratigraphy before the Palpa Project. Reindel and Isla put a focus on the acquisition and dating of ^{14}C samples from suitable contexts from the very beginning of their works. They chose sites for excavation where surface remains attributable to different style phases were observed in order to get samples covering the whole sequence. In 2006 Ingmar Unkel (2006) presented his PhD thesis on the numeric dating of samples from several sites in the Palpa area. He combined the stratigraphic evidence with the calibrated ^{14}C ages to work out a numerically dated chronology scheme for the NGD, which should as well be applicable to the SGD and to the Ica valley.

Most samples were dated employing an accelerated-mass-spectrometer (AMS). This method separates the carbon isotopes by their mass, allowing a direct count of atoms rather than detecting decay events. The major advantages are a higher accuracy and less required sample material. The standard errors given by the laboratories of Lundt, Heidelberg, and Zürich do usually not exceed 50 years. Unkel's chronology has been repeatedly reworked since. Newly available measurements were incorporated and the chronological model was revised and refined (Siegle 2007, Unkel & Kromer et al. 2007, Unkel & Kromer 2009). The latest version has recently been published (Unkel et al. 2012) and is based on more than 150 samples (Figure 30).

Despite the large number of measurements and the high accuracy of the AMS method, some uncertainty still remains. Above all, samples representing a certain phase often originate from only one to three sites, but there is no assurance that these sites were occupied during the whole phase in question. This issue is especially problematic for the Initial Nasca and the Early-Middle Wari phases. Furthermore, all sampled sites, except Cutamalla, are located at the foothills, so it is not clear if the highlands follow the same chronology. It cannot be ruled out that there was a certain temporal offset between style development at the foothills and its introduction in the *cabezadas* or vice versa (Unkel et al. 2012:2301). However, these limitations could easily be overcome by the future incorporation of new data from other sites. For now, it has to be assumed that the available samples are representative of their respective phases and for the entire study area.

The chronological overlapping of styles is another issue. Innovations usually do not become a standard overnight and need time to spread and become popular. This process can take several decades, and during that time new and old styles are in use simultaneously. In the scheme depicted in Figure 30, the blue stripes indicate a temporal overlapping of samples from neighboring phases, including statistical error ranges, while the grey area marks a gap for which no datings are available yet, because no sites which could belong to the respective phases have been identified so far in the NGD.

Later on, some analyses will take into account the differences in the length of phases (Chapter 5.3). In order to give a realistic impression of the possible error margins of the numeric chronological model,

⁸⁹ A number of factors can cause fluctuations in the atmospheric ^{14}C content, particularly varying sun activity (Vries 1958), massive burning of fossil, ^{14}C -free carbon since the 19th century (Suess 1955), and the employment and testing of nuclear weapons between 1945 and 1963 (Taylor 2000). Ziółkowski gives a good overview over possible sources of error in his compilation of ^{14}C measurements from the Central Andes (2009). Errors caused by ^{14}C fluctuations can be dealt with through calibration by measuring samples of known age, particularly wood, which can be dated independently through tree ring counting (dendrochronology, Stuiver et al. 1986), and coral reefs (Chiu et al. 2007). A calibration curve widely accepted and applied today is the IntCal09 curve (Reimer et al. 2009).

three different calculations will be made for each phase: one based on the most likely duration, one based on the shortest, and one based on the longest possible duration, according to Table 4.

Phase	Likely Start	Earliest Possible Start	Latest Possible Start	Likely End	Earliest Possible End	Latest Possible End	Likely Duration	Longest Possible Duration	Shortest Possible Duration
Middle-Late Ica / Inca	1180 CE	1130 CE	1250 CE	1532 CE	1532 CE	1532 CE	352 yrs	402 yrs	282 yrs
Hiatus	850 CE	850 CE	850 CE	1180 CE	1130 CE	1250 CE	330 yrs	400 yrs	280 yrs
Early / Middle Wari	640 CE	620 CE	660 CE	850 CE	850 CE	850 CE	210 yrs	230 yrs	190 yrs
Late Nasca	440 CE	410 CE	470 CE	640 CE	620 CE	660 CE	200 yrs	250 yrs	150 yrs
Middle Nasca	300 CE	270 CE	340 CE	440 CE	410 CE	470 CE	140 yrs	200 yrs	70 yrs
Early Nasca	80 CE	40 CE	110 CE	300 CE	270 CE	340 CE	220 yrs	300 yrs	160 yrs
Initial Nasca	260 BCE	330 BCE	130 BCE	80 CE	40 CE	110 CE	340 yrs	440 yrs	170 yrs
Late Paracas	380 BCE	400 BCE	360 BCE	260 BCE	330 BCE	130 BCE	120 yrs	270 yrs	30 yrs
Middle Paracas	500 BCE	560 BCE	440 BCE	380 BCE	400 BCE	360 BCE	120 yrs	200 yrs	40 yrs
Early Paracas	840 BCE	900 BCE	800 BCE	500 BCE	560 BCE	440 BCE	340 yrs	460 yrs	240 yrs
Initial Period	1500 BCE	1500 BCE	1460 BCE	840 BCE	900 BCE	800 BCE	660 yrs	700 yrs	560 yrs

Table 4: Start, end, and duration of phases in calendric years. In some cases there are too few ^{14}C measurements to accurately define the temporal limits or measured time spans are overlapping. It is therefore possible that some phases were actually significantly shorter or longer than assumed. Table: VS.

5.2.3 Population Size Classification

Population dynamics is a key aspect in settlement patterns analyses (cf. Kowalewski 2008:238-239, Parsons 1972). When focusing on questions about population growth or decline in a certain region, it is important not only to consider the number of settlements per phase but also to distinguish between small villages and large towns. A number of different proxies have been proposed for the estimation of population size from archaeological remains (Drennan et al. 2003, Chamberlain 2009, Hassan 1981:63-93, Sanders et al. 1979), but those most widely employed are site or settlement area and number of dwellings (cf. Fletcher 1986, Plog 1975). These are also the most suitable proxies for an analysis of regional-scale data like those of the Palpa Project. The basic assumption is that a settlement occupying twice the area of another or containing twice the number of houses likely housed about double the number of inhabitants. However, this approach causes some analytical problems as discussed by Schreiber and Kintigh (1996), who compared the archaeological evidence in the Sondondo valley with early colonial census data. For example, it has to be considered that the density of residents is relatively low in settlements that contain large plazas, administrative facilities, or especially roomy elite residences, compared to others of a comparable size, which consist exclusively of clustered common dwellings.

Many large sites in the study area predominantly consist of pens, geoglyphs, or agricultural terraces with only few dwellings dispersed in between. Accordingly, only few people lived there. Other sites are relatively small in area but a considerable number of stone houses stand closely packed, suggesting a dense population. Furthermore, many villages had been occupied in several phases, but judging only from some diagnostic ceramic sherds scattered on the surface it is hard to tell how many houses were in use during which phase. As is to be expected, excavations at some sites have shown that visible architectural remains in their majority tend to date to the youngest occupation. They are often constructed on the basis of older houses from preceding phases. Many sites located at the foothills, in turn, do not show any superficial remains of dwellings at all, due to the use of light wattle-and-daub construction technique, lack of stone foundations and destruction caused by looting. Here, the investigator has to rely predominantly on area to make a judgment on population size. Sometimes, artifact density (especially of diagnostic sherds) may also vaguely indicate differences in the intensity

or duration of site use. There are, however, many locally different factors influencing the distribution of material, including post-deposition processes of, covering, exposure, and repositioning. A direct proportionality of surface artifact density and population size should therefore not be assumed (Given 2004).

In sum, it can be stated that different types of occupation within a single site sector can vary significantly in extent and in the density of associated archaeological remains. Furthermore, the intensity of dwelling can fluctuate over time and differ from site to site. Consequently, the total of the full areas of all sectors that form part of a settlement can by far exceed the area actually dedicated to habitation at a given time. As the smallest spatial unit available for analyses is that of an entire site or site sector, some kind of corrective factor has to be introduced to express differences in dwelling density and to indicate the portion of the sector's area that is estimated to have actually formed part of a given settlement. Otherwise, all statistics and classifications based on settlement area would be misleading.

The problem was dealt with by adding a numeric field to the settlement database in which the percentage of a site sector's area is stored that is estimated to have formed part of a settlement (see Chapter 5.2.5). An example: a site has an extension of 10 ha, but mostly consists of large pens. Only some foundations of houses dispersed between the pens were observed. If it is estimated that only about 5% of the site can be regarded as habitation area during a given phase, the percentage field is set to 5%. The settlement area is now calculated as 0.5 ha, rather than 10 ha. If the same settlement also comprises 50% of a neighboring 3-ha-site, its total area would be 2 ha (5% of 10 ha + 50% of 3 ha).

This corrective factor is admittedly vague and subjective. It is based on the general site descriptions in the documentation of the Palpa Project, which often mentions details about the distribution of surface material from different phases within a site, and on my own observations in the field. Besides the limited accuracy of the method, the resulting settlement areas should be directly comparable to each other. The error may still be considerable in individual cases, but it should be small enough on average to identify general trends when taking into account hundreds of settlements.

Each settlement was judged individually in order to gain a rough idea of its relative population size. When conservation was good, the number of houses was considered a more reliable indicator than the dwelling area. This applies essentially to some stone-built highland settlements. Otherwise, the classification was based on the calibrated habitation area. From settlements with well-preserved dwelling remains, an average density of about 20 houses per hectare could be deduced, and it is hoped that this value is not dramatically different for less well preserved settlements where no dwellings could be counted. It corresponds more or less to the figure that Parsons et al. (2000:94-98) determined in the upper Mantaro drainage, using the same method of counting domestic stone structures, comparable in form and size to those present in the *cabezadas* section of the study area.

Guessing absolute population numbers is consciously avoided in the present study because there are too many unknown variables, ranging from conservation and registration issues to unknown average numbers of inhabitants per dwelling unit (cf. Osborne 2004). Such estimations might once become possible for particular settlements if they are excavated completely. For the much coarser data predominantly gained from surface surveys, however, assessing absolute numbers of inhabitants is inappropriate. Instead, a five-tier scheme according to Table 5 was used for relative classification. Since there are no obvious class breaks, the delimitation of these classes is arbitrary. The variance within each class is illustrated in Figure 25, which shows a histogram of the settlement areas grouped by population size classes. For each class there are also some settlements with an above-average density of countable house structures. These were assigned a higher class than their area would suggest, leading to the kerfs in Figure 25. Conversely, in some rare cases the density is below average (peaks). In Chapter 5.3, methods to determine an overall population development will be discussed which are based on total settlement area per phase. In these calculations, the number of houses is not considered which might lead to some error. Given the relatively low number of cases with unusual densities in all phases, this should nevertheless not significantly distort inter-phase comparison.

Population Class	Dwelling Area (ha)	Number of Dwellings
Population Center	>5	>= 100
Major Settlement	1.5-5	30-99
Small Settlement	0.5-1.5	10-29
Small Hamlet	0.2-0.5	4-9
Isolated Dwellings	<0.2	1-3
No Permanent Domestic Occupation	-	-

Table 5: Population size classification of settlements according to the indicators "dwelling area" and "number of dwellings." If preservation is good, the number of dwellings is considered the more reliable indicator. Table: VS.

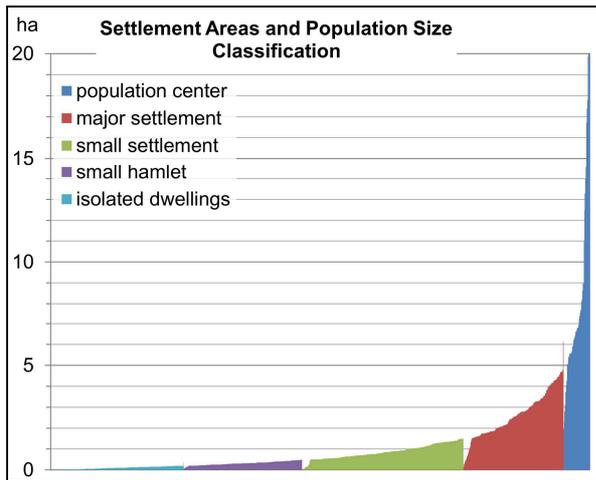


Figure 25: Histogram showing the area of all settlements, grouped by population size class. A number of settlements have an area smaller than that regarded as typical for a certain class, but the number of dwelling remains is relatively high (kerfs). They have therefore been grouped together with settlements that are more extended but contain roughly the same number of house structures. The opposite case – extended settlements with significantly fewer houses than others of a comparable area – occurs only in very few cases (peaks). Graphic: VS.

The quantitative relation of population size classes is shown for each phase in Figure 26.

5.2.4 Status Classification

Apart from their population size, settlements can further be classified according to their assumed status in a settlement hierarchy. Settlement hierarchies in archaeological studies generally draw on the central place theory of the geographer Walter Christaller (1968 [1933]), which was developed using early 20th century Southern Germany as a case study.⁹⁰ In Christaller’s model, higher-status settlements have additional functions and provide special services and facilities not available in lower ranking ones. In an ideal space with evenly distributed resources and without natural obstacles, settlements of the same rank would tend to be placed equidistantly around a higher ranking center.⁹¹ In practice, neither such an ideal space exists (this is especially true for the highly diverse landscape of the Central Andes) nor are certain functions always strictly bound to a distinct settlement rank (Ev-

ans & Gould 1982).

In many archaeological studies a relation is postulated between site size and position in a settlement hierarchy (e.g., Drennan & Peterson 2004, Johnson 1981, Peterson & Drennan 2005, Voorrips 1981). This approach should be seen critically, first because site size is generally not distinguished from

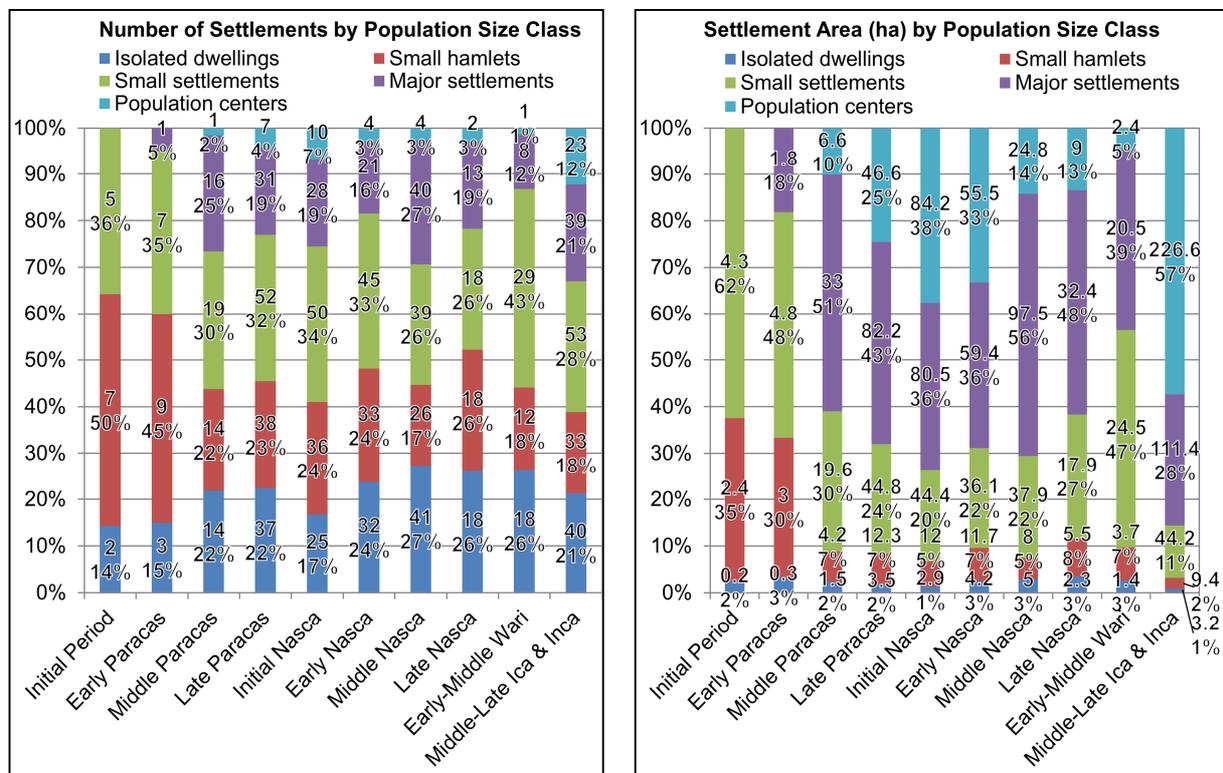


Figure 26: Numbers and total areas of settlements assigned to the different population size classes. Graphics: VS.

⁹⁰ E.g., Bell & Church 1985, contributors in Grant 1986.

⁹¹ See Heinritz 1979 for an overview of practical applications and further developments of Christaller’s original theory.

settlement size, and, second because settlements with a large population were not necessarily those where administrative and other special facilities concentrated, although such a relation might often actually have existed. When regarding settlement patterns of past or present societies, in most cases, there are nevertheless indicators that do point to differences in general importance. It therefore makes sense to distinguish common villages from centers, although the criteria may be fuzzy at times. Depending on the degree of political complexity, centers with administrative functions on several levels may or may not have existed during a certain phase (Ames 2009).

In case of the study area, status classification has to rely on archaeological remains alone due to the lack of written records. Since in most cases, no excavations have been realized, superficially visible architecture and the debris resultant from looting activity are the principal sources which have to be relied on. This bears a high risk of inadequate classification in individual cases. The high number of analyzed sites should nevertheless help to compensate for such errors and the reconstructed settlement hierarchies should come satisfyingly close to the actual situation in different phases of the pre-Hispanic past.

Settlements which can be regarded as centers were politically and administratively superior to the surrounding ordinary hamlets and villages. It can be assumed that such a difference in rang is expressed in:

- a demonstration of prestige and power
- an increased need for protection and/or control
- administrative activities such as collecting and redistributing goods
- larger-scale public ceremonies
- the permanent presence of social elites

The following features are regarded as indicative for a center status of a settlement:

- structures with outstanding architectural features in terms of
 - building material
 - size
 - construction technique
 - shape
 - functional aspects
- a regular settlement layout, apparently planned by an authority
- large platforms and artificially leveled hilltops used as public gathering spaces
- elite tombs
- especially elaborate residences
- defensive or enclosure walls

Two additional features have to be taken into account, which are less indicative because they can also be observed at some common settlements. Therefore, they should not constitute the only argument for classifying a settlement as a center:

- an area far beyond the average
- an especially strategic or defensive location

In most cases only some of the listed features are observable. Since it is often difficult to decide whether a settlement should be classified as common or as a center, a certain degree in subjective judgment is impossible to avoid. As each phase has different architectural traditions, a potential center has to be compared to contemporaneous settlements in order to determine if, for example, a certain building technique is special or common. Additionally, in most phases, there are clear differences in building techniques and settlement design between *cabezadas* and foothill settlements that have to be taken into account.

In the following a center that was superior only to some common nearby villages will be referred to as a *simple center*. It may itself have been subordinate to a settlement of higher rang which should show several of the indicative features listed above and these should be especially pronounced. Settlements of that level shall be termed *local centers*. Inside the NGD, there are no clear candidates for higher ranking centers, but in some phases such places are known to have existed in neighboring regions. Namely, Cahuachi in the SGD probably had a capital-like function for an extended political entity which also included the NGD. This class of settlements shall be referred to as *regional centers*.

During the Middle and the Late Horizon, the Wari and the Inca established large empires that controlled much of the Central Andes, including the study area. Their capitals, Wari and Cusco, respectively, can therefore be seen as *super-regional centers*. Both empires established colonies in the NGD from which the imperial rule over the region was exercised and where administrative specialists dispatched from the capital resided. In both cases, government seems to have been indirect by trend, allowing a coexistence of foreign overlords and local elites and the persistence of traditional political structures.

Consequently, in the Early-Middle Wari and Late Ica & Inca phases, it has to be distinguished between native centers and *foreign administrative centers*. Furthermore, there are some sites consisting of only a few small structures which are of very regular outline, well-built, and which resemble the typical imperial (Wari or Inca) architectural style. These constructions possibly belonged to control posts along important routes and maybe also had some limited storage functions. They will have been inhabited by only a few persons at a time. These small but special settlements are referred to as *foreign administrative posts*. The quantitative relation of the different status classes is shown for each phase in Figure 27.

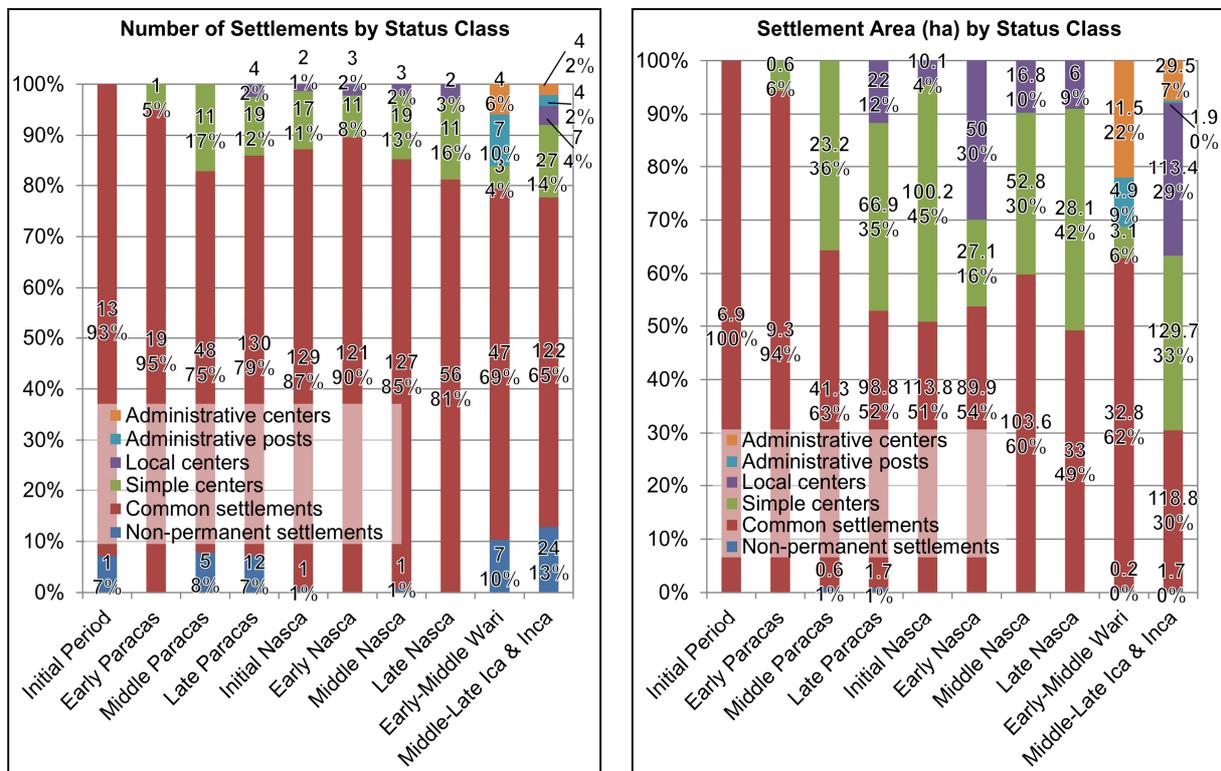


Figure 27: Numbers and total areas of settlements assigned to the different status classes. Graphics: VS.

5.2.5 The Settlement Database

The storage of data concerning the classification of settlements required a specialized database. As explained in Chapter 5.2.1, the concept of a settlement differs from that of a site. Consequently, other categories were needed for the classification of settlements than those adequate for sites. Although it would have been possible to add the new tables, queries, and user forms necessary to handle the information on settlements to the existing site database, it seemed more appropriate to keep the general project database separated from the special structures designed to meet the requirements of this specific study. Accordingly, a separate settlement database was created to which all necessary tables of the project database were linked in order to avoid redundancies.⁹²

The main table of the new database holds the basic information on the settlements (Figure 28). It is linked in n:m relations with the site and the sector tables in the site database (via *tbSettlementsSites*

⁹² The settlements database can be found in the "SettlementsDB" folder on Supplement DVD 1. In that version, the linked tables from the project (site) database were made permanent, so that it can be used as standalone.

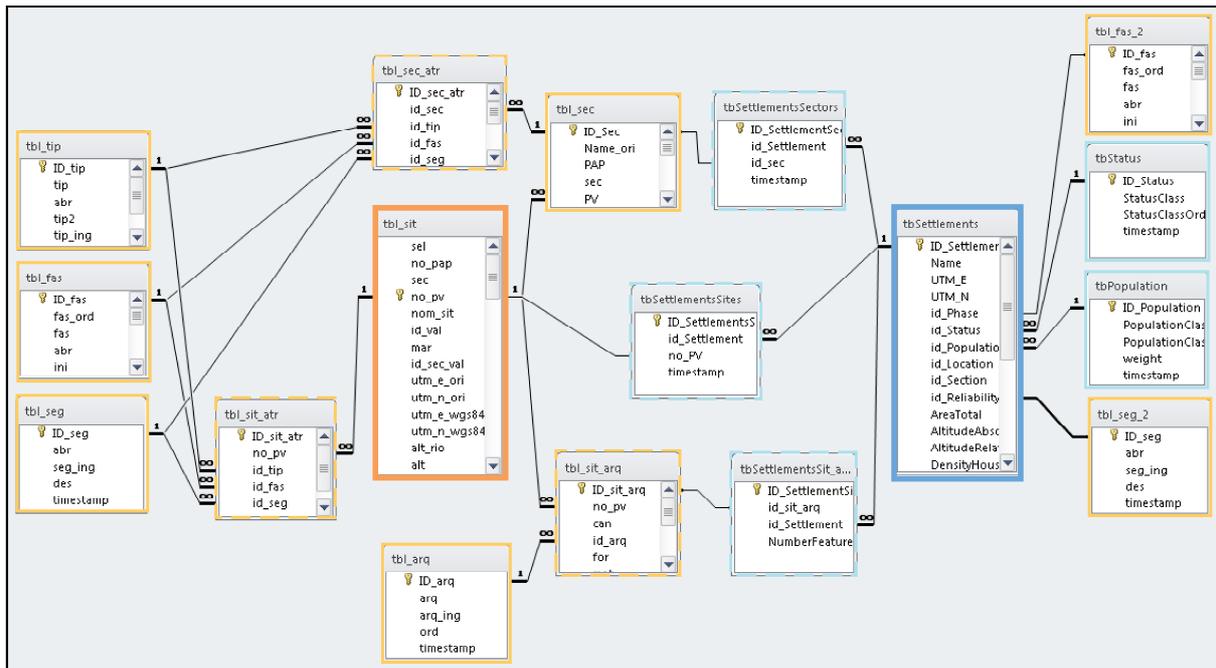


Figure 28: Relations of the most important tables in the settlement database. The tables with an orange frame are linked ones that are actually stored in the site database. The dashed frames mark the auxiliary tables needed to create many-to-many relations. Graphic: VS.

and *tbSettlementsSectors*, respectively) because each settlement can comprise several sites and sectors and every site or sector that has domestic occupations of more than one phase forms part of a corresponding number of settlements. Furthermore, tables were created for status and population size classes in compliance with Chapters 5.2.3 and 5.2.4 which were linked to the settlement table as 1:n.

The table holding the architectural features attributed to sites (*tbl_sit_arq*) is linked to the settlements as n:m via the auxiliary table *tbSettlementsSit_arq*.⁹³ This relation type is necessary because it is often not clear to which phase certain structures date, especially when there are occupations of successive phases. In these cases, the structures were related to all settlements in question. In general, the quality of the information on architecture varies greatly from site to site. This table should rather be regarded as a supplement to the general site description and was not used for analyses.

tbSettlements is also linked in 1:n to the phase table and to the table containing the categories for the reliability of classification. In the settlement database the latter is used to indicate whether the assignment to a phase and/or the domestic character of the site(s) or site sector(s) forming part of a settlement are considered to be certain or doubtful.

Figure 29 shows the main user form of the settlement database. On the upper left, basic information about the current settlement's location and classification is handled (green fields). Below, those settlements of the previous and the succeeding phases are listed, which include at least partly the same site(s). Further down, the architectural features associated with the current settlement are listed. These were observed at one of the site sectors from the list on the center left (which in other cases may belong to different but neighboring sites). On the lower left, the site description of the active site sector is shown (which is derived directly from the linked site table in the site database). On the right, the list fields can be used to filter settlements according to their size, status, and/or phase, but custom selections are also possible.

The list of executable functions serves the purpose of data maintenance. Given the large number of more than a thousand records, checking for errors and keeping consistency constitute major challenges. This is especially true as new data had to be incorporated every year (the corpus for this study was closed until December 2011). Repeated manual revision would have required a lot of time and manpower and thus was not a realistic option. Furthermore, no human can be expected to work without making mistakes. It was therefore worth the effort spending many month programming in order to automate data revision to a notable degree. Since the settlement definition in Chapter 5.2.1 can be

⁹³ The table *tbl_arq* holds a (incomplete) list of types of structures such as houses, pens and storage pits observable at a given site, including their form, size, and number.

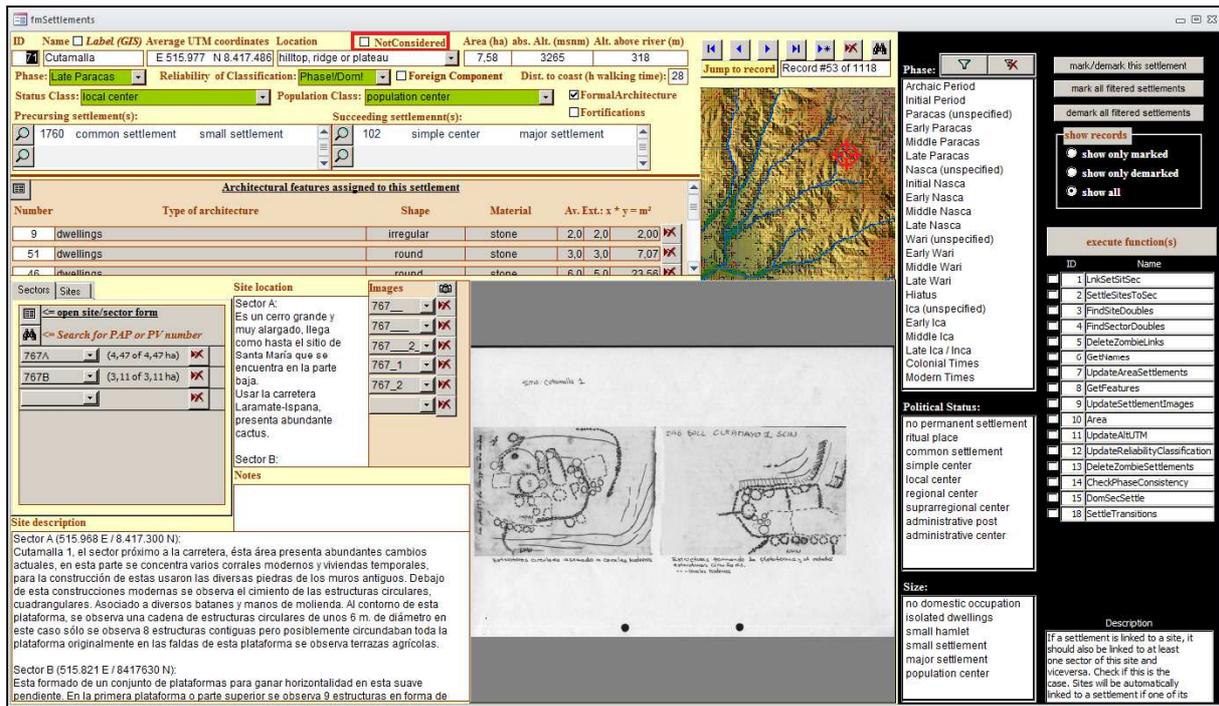


Figure 29: The main user form for data managing of the settlement database. On the upper left, information on the location and categorization is stored. The cross hairs on the mini map move according to the coordinates of the current settlement when browsing through the records. Below, the linked sites and sectors are listed and the corresponding field descriptions can be read. For most sites, low resolution overview photos, especially screenshots taken from Google Earth®, can be shown. The black area on the right offers tools for filtering, error checking, and launching some automated linking functions. Graphic: VS.

translated into logical rules, these rules can be used in VBA functions to check and fix errors. For example, the same sector must not be linked to several settlements from the same phase, a settlement's area must not exceed the summed up area of all sectors assigned to it, and so on. Wherever possible, calculations and record linking had been automated, but as no programming is immune to bugs, regularly run checking functions are necessary to ensure consistency and to verify that all code is working correctly.

The classification of settlements and the calculation of growth and dislocation rates (to be discussed in the following chapter) enable a more detailed comparison of the settlement patterns of particular phases. Via a VBA function the corresponding values for each phase were calculated and written to a table, which, in turn, forms the source of the settlement database report *rpStatistics* (Figure 31).⁹⁴ This report resumes the most important information for each phase including:

- numeric dates and phase length
- number and area of settlements, differentiated by occupation types
- growth and dislocation rates
- absolute numbers and total area grouped by status and population size classes

The same table was also linked to an Excel® workbook in order to design charts and diagrams, since the respective features in Access® tend to be buggy and limited in their formatting options.⁹⁵

The code underlying the project database and the settlement databases taken together comprises some 100-200 A4 pages, depending on formatting, and cannot be treated in detail here.⁹⁶ Most of the code itself is commented but I do not claim that it meets professional standards. Different sections may be of a different quality, according to my own learning process and accumulated experience. As the complete programming was a one-person effort, I was unable to invest even more time and labor in the refinement of the code.

⁹⁴ The overview sheets for each phase are presented in Chapter 6.

⁹⁵ The workbook can be found in the "Charts" folder on Supplement DVD 1.

⁹⁶ The underlying calculations and criteria will be discussed later on but not their actual translation into VBA code. Open the settlements database in the folder "SettlementsDB" on Supplement DVD 1 and hit Alt+F11 to see the details in the VBA Editor.

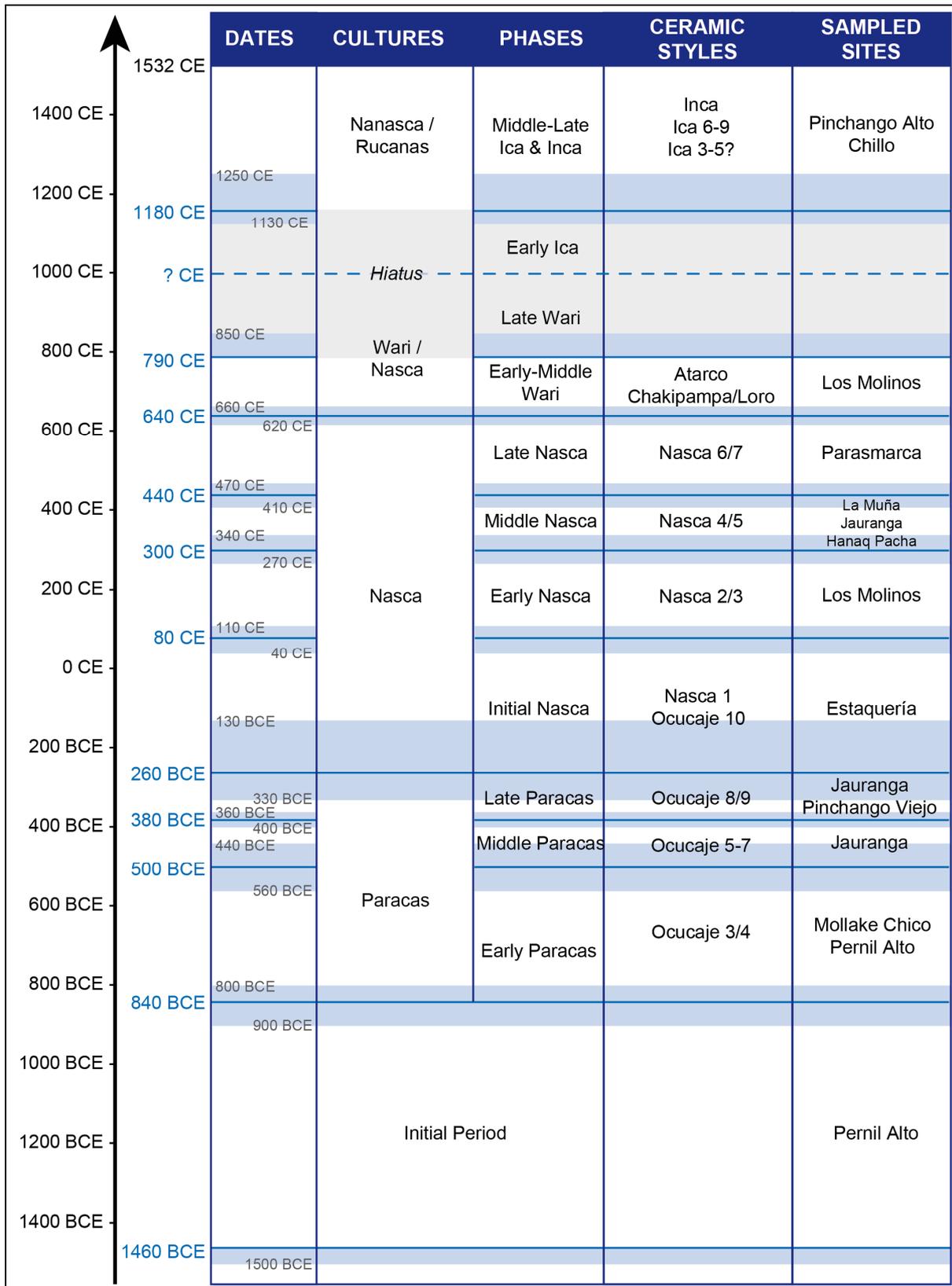


Figure 30: The latest version of the chronology scheme published in Unkel et al. 2012 with minor layout changes. The blue stripes indicate probability ranges for phase boundaries. The grey date labels give the earliest/latest possible beginning/end of a phase. The grey area marks a data gap. Graphic: VS after Unkel et al. 2012, p. 2299.

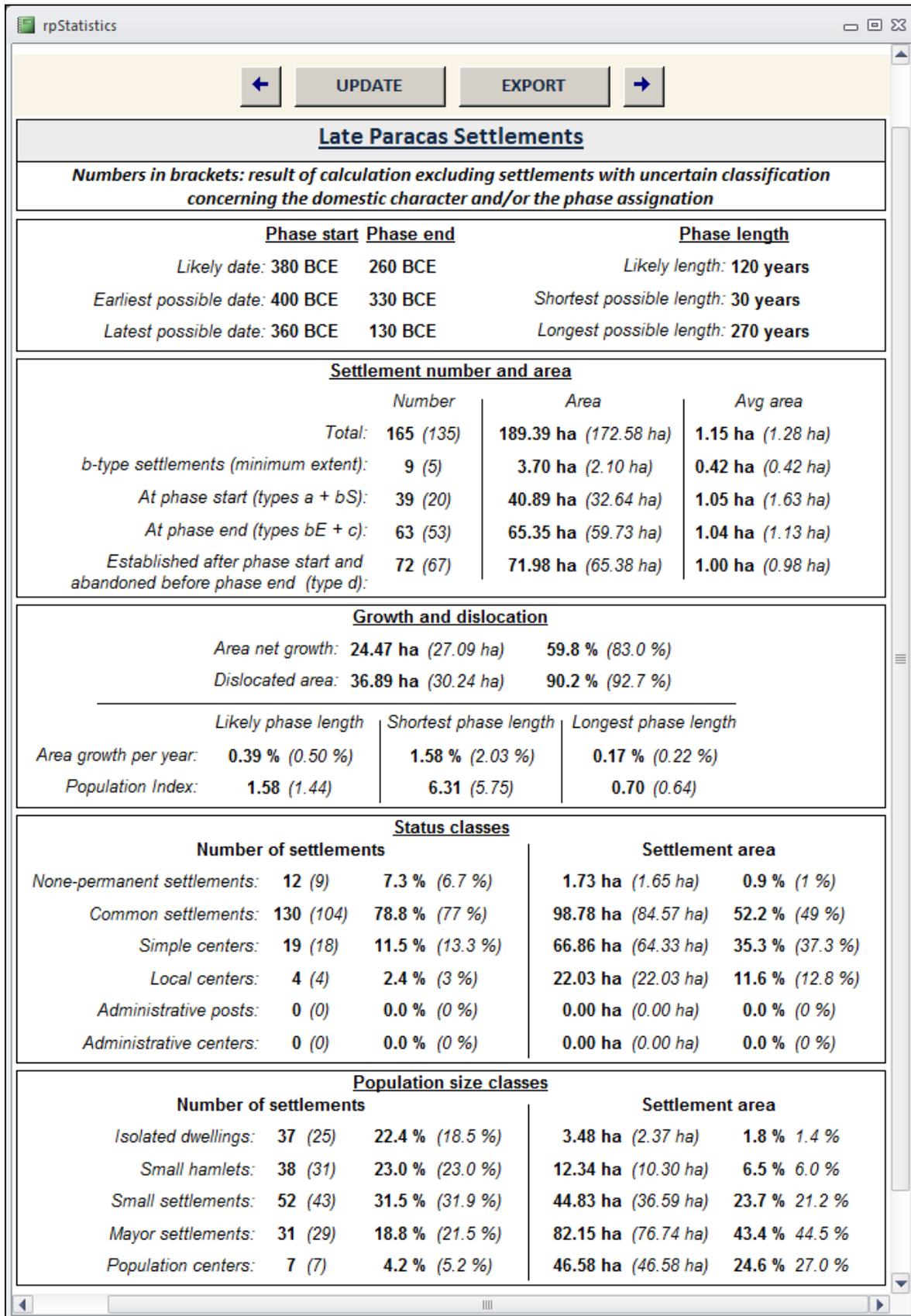


Figure 31: The report rpStatistics in the settlement database showing data of the Late Paracas phase. The data sheets for each phase are presented in Chapter 6. Graphic: VS.

5.3 Population Development and Dislocation of Settlements

One of the key questions in diachronic settlement pattern analysis concerns population development. Did population levels rise or fall? Did they change slowly or suddenly? Since the 1960s, a number of studies in different regions of the world have made efforts to model demographic changes by using different quantitative parameters like number and area of settlements, number of domestic structures, volumes of debris, etc. (e.g., Ammerman et al. 1976, contributors in Bintliff & Sbonias 1999, Blanton 2004:214-222, Drennan et al. 2003, Plog 1975, Sanders et al. 1979:34-40). In his 1981 volume, Fekri Hassan gives an overview over several approaches for an estimation of absolute population sizes from archaeological data with a special focus on ethnological parallels (Chapter 6). In the early 1980s, Robert Schacht (1980/1982) also published various articles on the same topic. A more recent overview is presented by Andrew Chamberlain (Chamberlain 2006/2009).

Drawing on an approach originally developed by Fred Plog (1975), Robert Schacht dedicated an article to what he calls the contemporaneity problem: when comparing the settlement patterns of successive phases, many villages might not have been occupied continuously throughout the phase they were assigned to (Schacht 1984, also see Ammerman et al. 1976:40 and Cohen 1975:471). Therefore, settlement distribution at the beginning of a phase could have been markedly different from the end and the number of settlements at any given point during that time section was almost certainly lower than the sum of all inhabited places assigned to it.

This issue was acknowledged early on, for example by Robert Adams in his study on settlements in Ancient Mesopotamia. At the end of the book he states that "it has been assumed throughout this study that all towns and villages which were occupied at any time during a given period were occupied simultaneously. This fails to take into account the probability that at least a few sites were occupied sequentially" (1965:124).

Despite the discussions of the 1970s and early 1980s, astonishingly few settlement pattern studies carried out in the Central Andes attempted to address the contemporaneity problem. Instead, population development was still widely reconstructed by simply comparing settlement numbers or settlement area of different phases (e.g., Parsons et al. 2000, Silverman 2002, Wilson 1983).⁹⁷

The problem has both a quantitative and a spatial component. The first becomes critical when estimating population developments and the second when reconstructing distribution patterns and site hierarchies. The probability of settlements being sequential rather than contemporaneous is higher the longer the phase lasted, leading to considerable distortions when comparing time spans of markedly unequal length. Ammerman et al. see two lines of solution to the issue:

One way to reduce the scope of this potential problem is, of course, to keep time intervals as short as possible. Another way of dealing with the problem where a sequence of intervals is being compared is to make the assumption (admittedly a potentially dangerous one in the context of dynamic growth situations) of proportionality between units occupied at specific times during intervals and the cumulative number of units occupied during the same intervals, which can be weighted according to their respective durations. (1976:40)

Concerning the first proposal, it has to be stated that, although the chronology for the South Coast is now relatively well established (see Chapter 5.2.2), some phases still span several hundred years which may lead to considerable distortions in the reconstruction of population dynamics. The second proposal is more promising and will be addressed in the following.

5.3.1 Population Index

One way to deal with the quantitative aspect of the contemporaneity problem is to relate settlement area to phase length. Using area instead of numbers is important, since the average area may have fluctuated significantly over time (Figure 32). Such a solution was applied, for example, by Harvey Weiss (1977) who revised settlement data from Khuzistan in southwestern Iran, published by Henry Wright and Gregory Johnson (1975). He summed up the total settlement area of each phase and divided it by the number of years that the phase lasted. By comparing the resulting indices (ha/year), the relative population development was reconstructed. This approach allows for a comparison of time

⁹⁷ An exception is the study by Isbell and Schreiber (1978) who compare only two periods (EIP and MH) in the Ayacucho region. They calculate the average settlement area per year in order to consider the duration differences between the two time sections.

sections of unequal length. If the sum total of the settlement area assigned to a phase is called A, the phase length in years P, and the resulting index I, then $I = A/P$.

It is important to note that this method works only when the average occupation span of ancient settlements remained more or less constant. This, however, might not have been the case always. The information gathered by the Palpa Project is predominantly derived from surface surveys and does generally not allow indicating precise occupation spans of specific sites. As a consequence, the same constant average occupation span is assumed for all phases but this assumption may prove wrong in the future. Furthermore, by treating all settlements assigned to the same phase collectively, the index approach makes it impossible to detect significant changes *within* a phase.

Since the index will change if a shorter or longer phase length is assumed, the uncertainty of phase lengths is another important consideration. As stated in Chapter 5.2.2.2, several phases cannot be delimited sharply. In order to demonstrate the potential impact of this error source population index values were calculated with the likely (P_{li}), the shortest possible (P_s), and the longest possible phase length (P_{lo}) (Figure 33). Although the latter two are very unlikely extremes, they illustrate the possible error range caused by chronological uncertainties. In some cases, the differences in the resulting indices can be so enormous that even completely contradicting statements about population development would still be within the error margins. The index approach is therefore only suitable if the phase boundaries are dated precisely.

5.3.2 Total Settlement Area at Phase Transitions

Drawing on a statistical growth model developed by Robert Schacht (1984), Robert Dewar (1991) went one step farther by considering occupation continuities of sites. He wrote a computer program to calculate the statistical likeliness of sites in the Basin of Mexico having been occupied at any given point in time. He assumes that a site showing occupations of two successive phases must have been in use at the time of transition from the earlier to the later phase. This continuity assumption may actually prove wrong in some cases: if a site was abandoned at the beginning of a phase and reoccupied at the end of the next, it would show remains of two succeeding time sections without having been in use at the point of transition. The longer the considered time intervals the higher is the probability that this was the

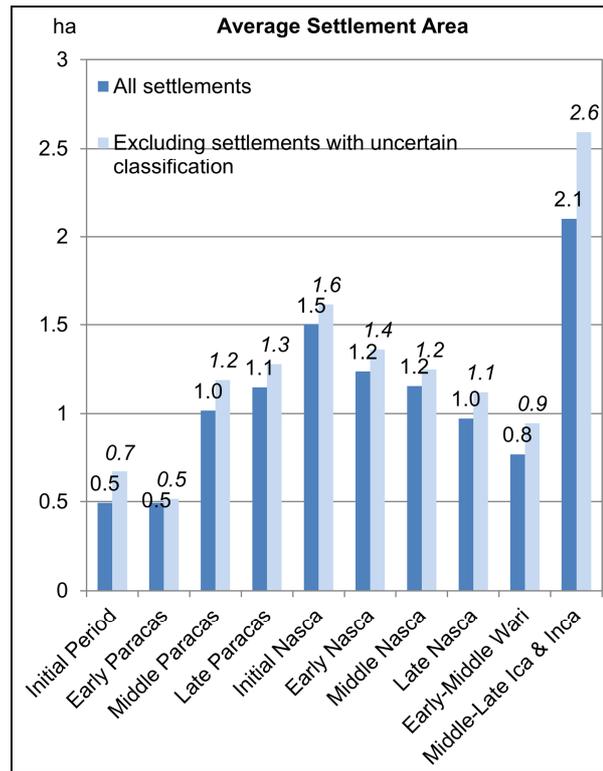


Figure 32: Average settlement areas for each phase. Graphic: VS.

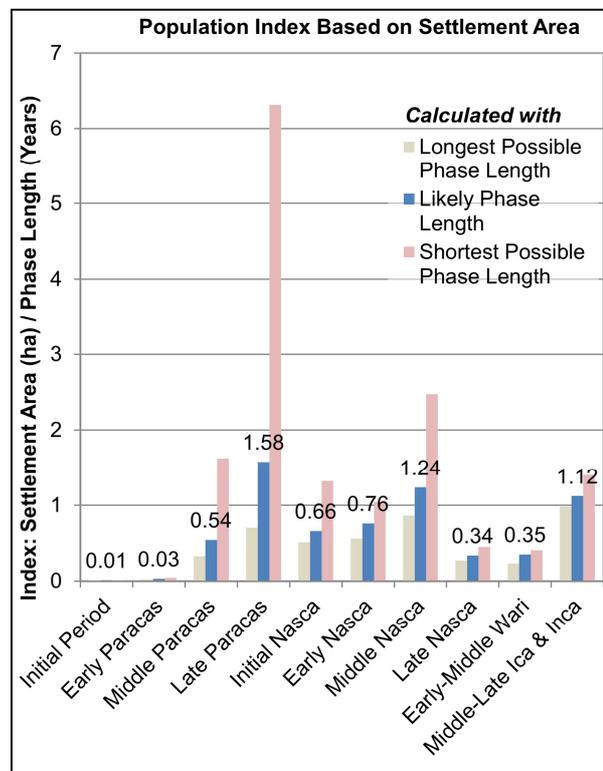


Figure 33: Index values calculated dividing the summed up settlement area of each phase by the phase length. Where phase lengths cannot be determined accurately, the error margins for the index value can be so extreme that a credible interpretation of the population development is hardly possible. Graphic: VS.

case. Dewar’s assumption should nevertheless be correct in most cases.

When regarding a phase Y preceded by phase X and succeeded by phase Z, Dewar groups all villages attributed to phase Y into one of four categories (Figure 34):

- a) villages already occupied in X but not any more in Z
- b) villages already occupied in X and still occupied in Z
- c) villages not occupied in X but still in use in Z
- d) villages without occupations in neither X nor Z (Y only)

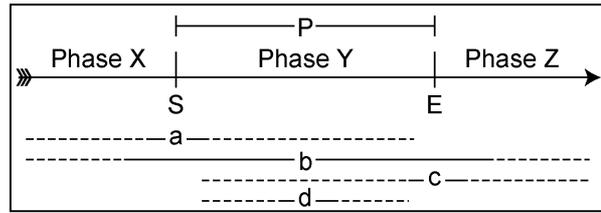


Figure 34: Occupation types after Dewar 1991. S is the starting year of Phase Y and E the year the phase ends (Dewar named these points t_1 and t_2 , respectively). Accordingly, P is the phase length in years. The exact occupation length of the settlements is not known (dotted lines), but it is known, if an occupation existed at S and/or E. Graphic: VS after Dewar 1991, p. 608.

He then divides the number of sites of categories a plus d (the ones that were not occupied anymore in the succeeding phase) by the length of the phase in years (P) to calculate the average yearly abandonment rate (settlements per year). Accordingly, the number of villages from categories c plus d divided by P gives the average yearly establishment rate.

In order to find out how many sites might on average have been occupied simultaneously during each phase, Dewar designed a computer simulation in which each site is established or abandoned with a certain statistical probability according to the respective establishment and abandonment rates. The more often the simulation is run, the lower the statistical error. However, Dewar (1991:609) also states that “[o]bviously, the model will predict a mean number of sites not far different from the number present at t_1 and t_2 [the start (S) and the end (E) of the phase]. The most significant outcome is probably the standard deviation of the estimate, which reflects directly the activity or flux in the settlements”.

The results, however, suggest an accuracy that does not reflect the fuzziness of the archaeological raw data. As did Weiss, Dewar calculated with fixed phase lengths. In practice, in contrast, the beginning and the end of phases cannot be determined with perfect precision and the ranges of insecurity may comprise several decades or even centuries. The impact of this error on the abandonment and establishment rates is significant. If, for example, $a + d = 100$ and $P = 200$ then the abandonment rate is $100 / 200 = 0.5$. If it turns out that the phase actually lasted for 250 years then the rate would drop to $100 / 250 = 0.4$. If it lasted for only 150 years, the result would rise to $100 / 150 = 0.67$. In this example, the error due to dating uncertainties would be fully 20% and 33.33%, respectively.

Dewar’s general approach of regarding *points* in time rather than whole multi-century sections is nevertheless very helpful for the reconstruction of population development. In order to raise accuracy, however, not site numbers but the settled area should be considered: it not only matters whether or not a site was occupied at a certain point in time but also how many people might have lived at that place. Population development can best be deduced from the comparison of settled area at the starting year S and the ending year E of a phase. In the starting year S of phase Y the total settlement area A_S is the sum of the areas of all occupations of types a and b. It is, however, possible that the area of an occupation at the same site sectors was smaller or larger in the preceding phase X. What is visible in the field comes usually close to the maximum extent of the occupation in each phase, but what was the situation at S? If it is assumed that growth and shrinking took place as steady-going processes, then two cases have to be distinguished (Figure 35):

- 1) If the area increases, the value for phase X should be at its maximum at S and equal the starting value for phase Y.
- 2) In turn, if the area decreases, then the value for phase Y should be at its maximum at S and therefore represent the occupation area at this point in time.

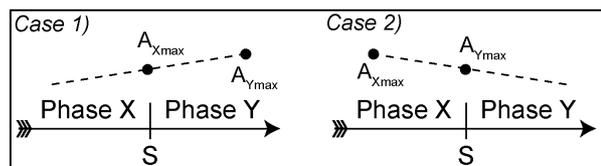


Figure 35: Growing and shrinking area of an occupation at the transition between two phases. A_{Xmax} reflects the situation at S if the area is growing and A_{Ymax} if it is shrinking. The archaeological record tends to preserve the maximum extent during each phase (A_{Xmax} and A_{Ymax} , respectively). Graphic: VS.

Accordingly, if the area of an a-type occupation was smaller in the preceding phase than in the phase in question, this smaller value should be

considered. The case is a bit more complicated for *b*-type occupations because they span the whole phase and could have had different extents at S and at E. Two values should therefore be distinguished for the respective occupation areas: the first representing the area at S (A_{bS}) and the second giving the extent at E (A_{bE}). Accordingly, the total settlement area at S (A_S) is the sum of the areas of all *a*-type occupations (A_a) and all *b*-type occupations with their extent at S (A_{bS}). The area at E (A_E), in turn, equals the total area of all *c*-type occupations (A_c) plus that of the *b*-type occupations with their extent at E (A_{bE}). Figure 36 shows for each phase the different types of settled area according to Dewar’s approach while Figure 37 displays the area settled at the phase transitions.

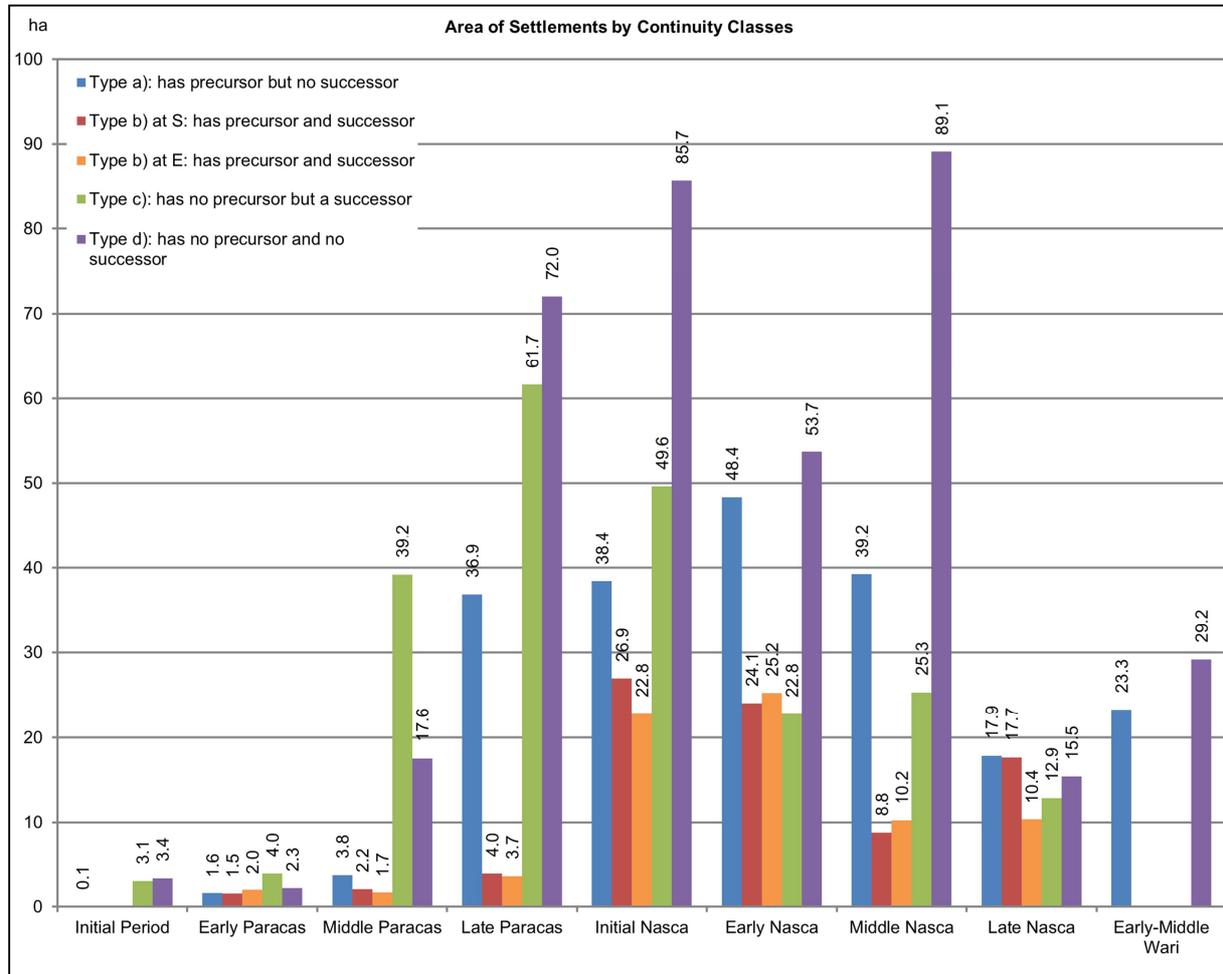


Figure 36: Occupation continuity of settled area following the classification proposed by Robert Dewar (1991). Graphic: VS.

The overall growth *G* (given in %) of the settled area between the start and the end of a phase (Figure 38) would calculate as:

$$G = (A_E - A_S) / A_S * 100$$

Schacht (1984) rightfully states that growth most likely did not take place in steps nor as a linear development. Instead, he discusses several variants of exponential growth functions because the added area (or whatever proxy is chosen) in each year augments the calculation base for the next year. Similar functions had also been proposed by Ammerman et al. (1976) and by Plog (1975).

The validity of sophisticated statistical growth models like those proposed by Schacht is almost impossible to verify by analyzing archaeological data alone. These models will therefore remain as speculative as simpler ones and do not offer a better accuracy. In the scope of the present study an average growth rate per year called *R* was therefore calculated as a simple exponential growth function. This value is only intended to serve as a rough indicator for inter-phase comparisons but it is not used to interpolate population numbers at a certain point in time or for similar calculations. There would be too many uncertainties challenging the validity of any conclusions drawn from the resulting values. The following equation determines the constant yearly percentage growth rate *R* necessary to get from A_S to A_E in *P* years:

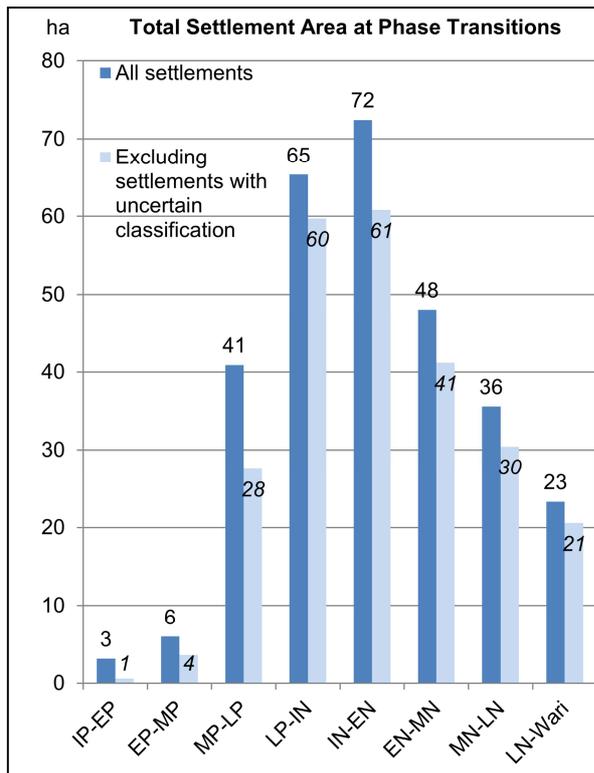


Figure 37: Total area settled at phase transitions. Graphic: VS.

$$R = 100 * (\sqrt[P]{A_E/A_S} - 1).$$

Again, the uncertainty about phase length has to be considered. The calculation of R was therefore repeated with the P-values for the shortest possible and the longest possible phase length (Figure 40).

Very likely, settlement area will not have grown or shrunken evenly during all phases. The presence of *d*-type occupations which were newly established during a phase but already abandoned before the end of that same phase hints to significant short-term fluctuations during some time sections. These short-term inner-phase developments cannot be reconstructed with confidence, given the limited temporal resolution of the available data, which was predominantly generated by interpreting surface remains.

It is nevertheless possible to determine the boundaries between which the actual settlement area curve could have oscillated (Figure 39). The lower extreme would equal the total area of all *b*-type settlements (which had likely been occupied throughout the phase) at their minimum extents.⁹⁸ It is possible, though unlikely, that for a certain time section within the phase all other settlements were either already abandoned (*a*- and *d*-type) or

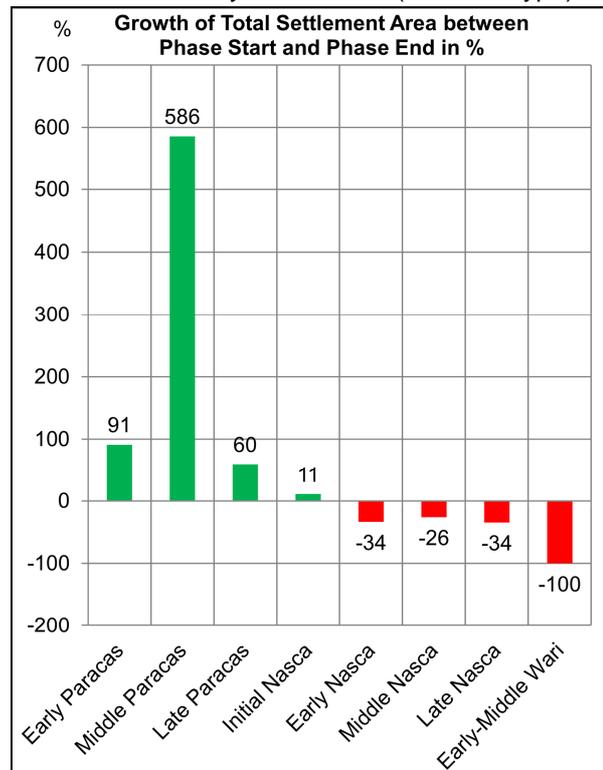
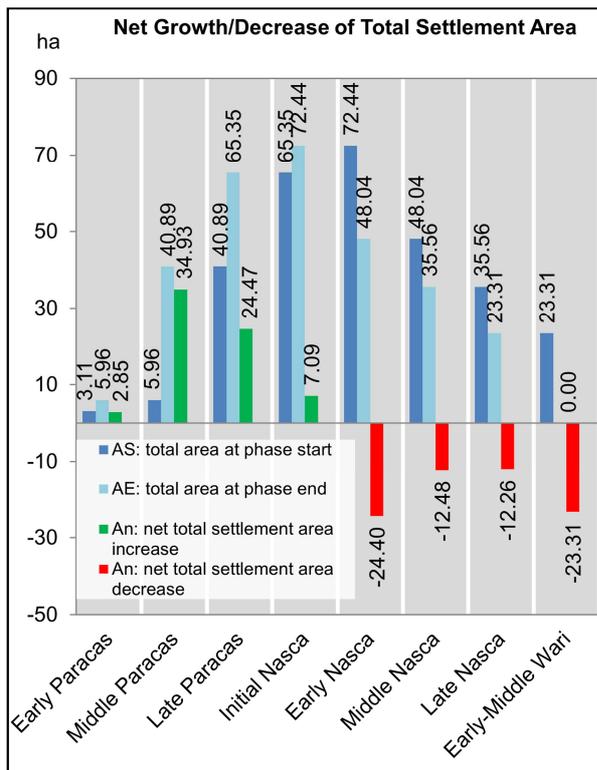


Figure 38: Growth and decrease of settlement area per phase in absolute numbers and as percentages. Graphics: VS.

⁹⁸ Note that a settlement may incorporate several sectors. If one of its sectors was occupied in the preceding but not the succeeding phase, and another one in the succeeding but not in the preceding phase, the settlement as a whole would still be classified as *b*-type. Since none of its sectors was occupied throughout the phase, the *b*-type area would nevertheless be zero. Area calculations performed in the settlement database are based on sector areas which may lead to the apparently paradox situation that for a certain phase the *b*-type area is calculated as zero although the number of *b*-type settlements is greater than zero.

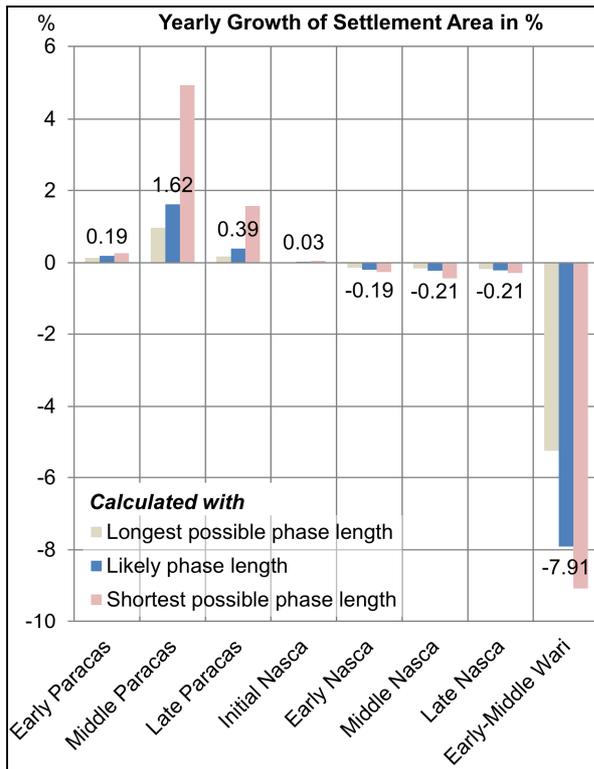


Figure 40: Annual growth rate calculated after a simple exponential growth function.

still not established (c- and d-type). The probability that such an extreme scenario occurred (and that the curve approximated the lower limit) grows the longer the phase lasted and the less d-type villages existed. In case of the opposite extreme, the occupation spans of all villages would have overlapped at least in one moment. Accordingly, the higher limit equals the total area of all settlements assigned to a phase. A population peak sometime in the course of a phase is more probable the shorter the phase lasted and the more d-type settlements existed.

In the end, the exact course of the settlement area (= population) curve within a phase will remain unknown. A hypothetical reconstruction is nevertheless possible by judging and discussing the probabilities of smooth growth or decline versus sudden and significant changes in population levels. For this task, the pure numeric values for a-, b-, c-, and d-type areas have to be complemented with the general archaeological evidence of a certain phase, which may shed light on aspects like resource availability, population exchange with neighboring regions, the frequency of armed conflicts, and others. This kind of reconstruction based on the interpretation of archaeological data is surely more accurate than

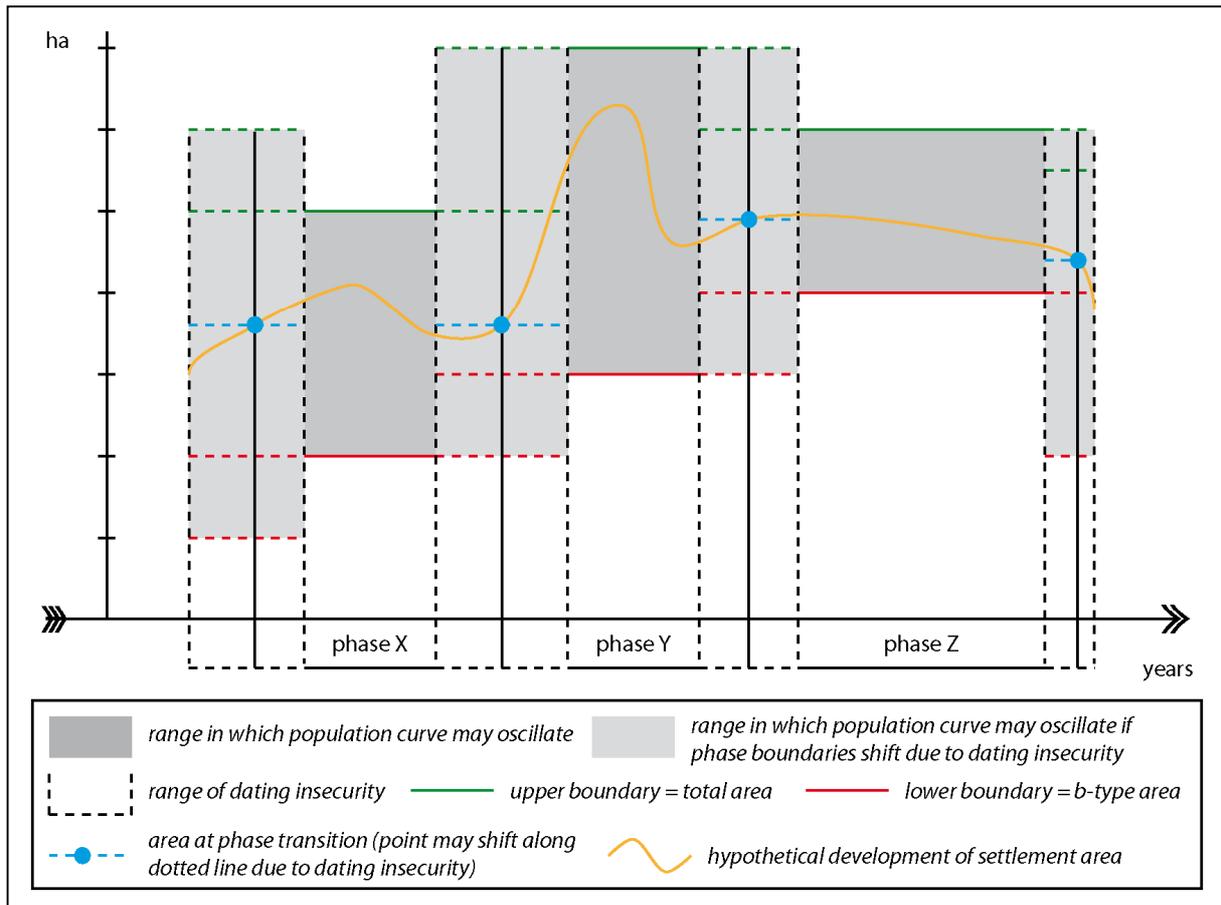


Figure 39: Schematic illustration of the reconstructed development of settlement area. While the area at the phase transitions can be determined more or less reliably, the development between the transitions can only be estimated, though the curve should run somewhere between the upper and lower boundaries. Graphic: VS.

the comparison of index values that do not take into account any inter-phase developments and also to any static algorithm, however sophisticated, which is applied indiscriminately to all phases.

5.3.3 Dislocation

The classification of occupation types following Dewar (1991) also allows determining how much settlement area had been dislocated between S and E. Dislocation is an important phenomenon that is heavily influenced by the general stability of a society. The massive movement of settlements to new locations may have been motivated by defensive considerations or by the need to get a more direct access to crucial resources. In these cases, dislocation observed in the settlement pattern can point to dramatic changes in the political or economic setting.

If settlements that existed at S were abandoned before E (type a) while others were established after S and stayed occupied at E (type c) then it is likely that the inhabitants of the former had moved to the latter in some moment during Phase Y. Existing settlements that grew during phase Y (type b, $A_{bE} < A_{bS}$) may also have absorbed some of the former inhabitants of abandoned villages. If the total settlement area at S was higher than that at E some settled area was abandoned without being replaced, which means that the population probably declined. In the opposite case, demographic development would have been positive (Figure 41). The dislocated (replaced) settlement area A_D alone without considering population growth or decline is the smaller of the values for A_a and A_c plus the difference between A_{bS} and A_{bE} , but only if A_b grew:

$$A_D = \text{Min}(A_a; A_c + \text{IFF}(A_{bE} - A_{bS} > 0; A_{bE} - A_{bS}; 0))$$

Dividing this value by the overall settlement area at S (A_S), the fraction of dislocated settlement area can be derived. Multiplying by 100, this fraction can be given in percent (%) and shall be referred to as the dislocation D:

$$D = 100 * A_D / A_S$$

Accordingly, in case 1a (shrinking settlement area) of the example given in Figure 41, the formula would result in a dislocation of 55%:

$$D = 100 * \text{Min}(75; 50 + 30 - 25) / 100 = 55\%$$

In case 1b, A_b is shrinking and thus must not be considered. Accordingly, the resulting dislocation is lower.

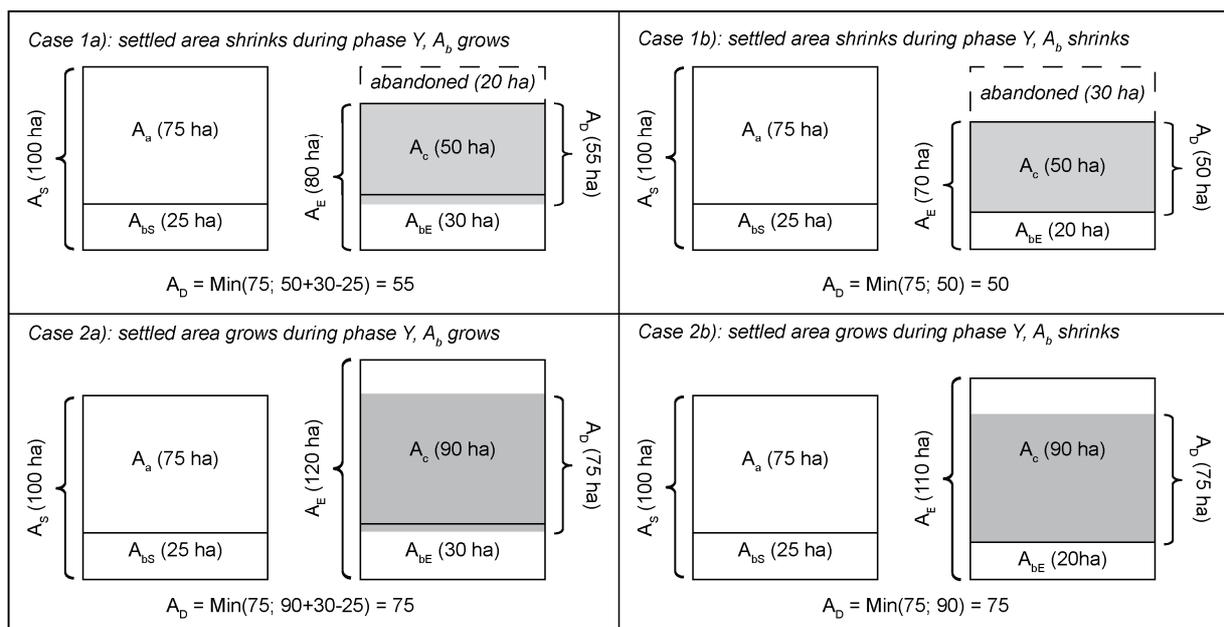


Figure 41: Example for the calculation of dislocated settlement area (grey) with fictive values. The abandoned area A_a could at least partly have been compensated by the growth of existing settlements (if $A_{bE} > A_{bS}$) and the establishment of new ones (A_c). Graphic: VS.

$$D = 100 * \text{Min}(75; 50) / 100 = 0, 50 = 50\%$$

In cases 2a and 2b the total settlement area grows and, statistically, all abandoned villages were completely replaced. Accordingly, in both cases A_D equals A_a and the dislocation corresponds to the relation of A_a to A_s while A_b is not relevant:

$$2a: D = 100 * \text{Min}(75; 90 + 30 - 25) / 100 = 75\%$$

$$2b: D = \text{Min}(75; 90) = 75\%$$

Figure 42 shows the resulting values if the method is applied to the settlement data of the Palpa Project. It has to be cautioned, however, that the study area is not a closed system. If, for example, people left the foothills and migrated to the SGD and, at the same time, other groups from outside occupied the highlands, a high D-value would result even though the local population did not dislocate their settlements inside the study area. In this case, what actually happened was a population exchange! Changes in architecture, burial customs, and pottery design should always be discussed alongside the mere numeric D-value when asking questions about dislocation.

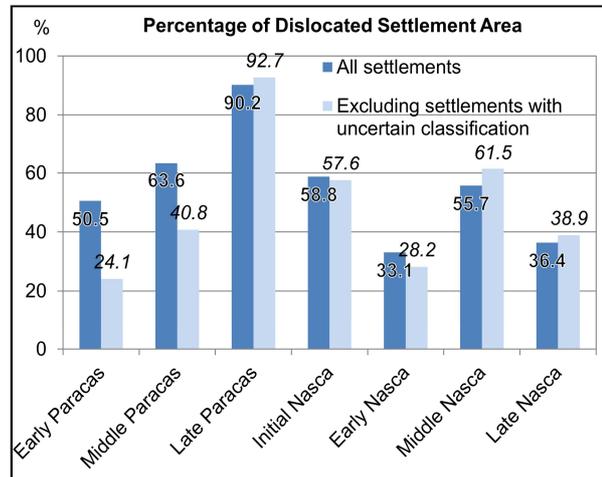


Figure 42: Dislocation of settlement area between the Initial Period and the Late Nasca phase. Since the Early-Middle Wari phase is followed by a hiatus (all known settlements were abandoned) the dislocation is 0%. Dislocation for the Middle-Late Ica & Inca phase is also 0%, because all settlements were newly established. Graphic: VS.

5.4 Spatial Analyses

With the classification of settlements and the calculation of growth and dislocation rates completed, a number of statements about long- and short-term developments in settlement patterns are already possible. The spatial relation between contemporaneous settlement of different size and status as well as their respective natural setting, in turn, are yet to be examined. Protection by the local topography and proximity to important resources certainly were particularly important factors when choosing a place for a new village. This may hint at times of peace or tension and to economic opportunities and necessities. Spatial analyses are therefore required to detect changes in settlement distribution and preferred location over time. These can best be performed with the help of a geographic information system (GIS).

During the last decades, GIS have become increasingly important tools for archaeology and a growing amount of literature about the topic is now available (Aldenderfer 2007, Conolly & Lake 2008, Maschner 1996, Mehrer & Wescott 2006, Wheatley & Gillings 2002). In the study of settlement patterns, GIS are often used for the creation of maps showing the distribution of settlements in a study area during different phases. Up-to-date software, however, not only offers all necessary functionalities for the design of such maps but also provides a variety of analytical tools for calculations far beyond the mere visualization of distribution patterns.⁹⁹

I worked with Esri's ArcGIS[®] 10 although this software still has many insufficiencies and bugs. Crashes, losses, and corruption of data are an everyday user experience. Nevertheless, none of the commercial or open source alternatives offer an equivalent set of tools and features and most suffer from an equally poor stability. All geodata has been projected to the Universal Transverse Mercator System (UTM), zone 18 (south), and uses the World Geodetic System from 1984 (WGS84) as spatial reference.¹⁰⁰

⁹⁹ Esri provides a guide for the use of GIS in archaeological projects, including some case studies, which is available for free as a downloadable PDF file (Esri 2009).

¹⁰⁰ A choice of basic geodata used in this study can be found in the "GeoData" folder on Supplement DVD 2.

5.4.1 GIS and Database Linking

In order to show settlements on a map and to calculate spatial relations between them and the landscape, each must be given coordinates in a spatial reference system. For area and proximity calculations, their shapes have to be defined. Since during fieldwork not settlements but sites were documented, delimitations are based on site sectors. Although most sites were originally registered with coordinates derived from maps or a hand-held GPS, these indicated the approximate center point very roughly while the site’s form and extension was described by words. In addition to the limited accuracy of such measurements and estimations, errors occasionally occurred during documentation by mixing up the old Provisional South American Datum from 1956 (PSAD56), used in older Peruvian maps, with the World Geodetic System from 1984 (WGS84), which is now a widely used international standard employed in most GPS devices.

This issue was addressed by a digital vectorization of the approximate limits of archaeological sites and sectors that was undertaken in 2011 by Johny Isla and Carolina Hohmann. Since they had been responsible for the original documentation of the vast majority of the sites, they had the best knowledge on the situation in the field and hence were best able to reconstruct the approximate site extensions. They used the high-resolution imagery available in Google Earth®, which had not covered the entire study area prior to 2011.¹⁰¹ Afterwards, the polygons were saved in Google’s kml format, imported into ArcGIS®, and converted into Esri’s shapefile format (shp) for further editing. Each polygon was given an ID number identical with the ID of the corresponding sector stored in the sector table of the site database. The polygon areas and the coordinates and absolute altitudes of its centroids were calculated in ArcGIS® via the *calculate geometry* option in the attribute table of the shapefile. The results were then copied into the site database and each sector was assigned the corresponding polygon attributes for area, coordinates, and altitude. The values for multi-sector sites were calculated as the average of the values of its sectors. These indications replaced the much less exact provisional measurements and rough estimates originally made in the field. Coordinates for a settlement were derived by averaging the coordinates of all site sectors related to it.

The site and sector polygons were then linked to a query in the settlement database which combines tables from the settlement database and linked tables from the site database (Figure 43). It comprises fields from the sector attribute (*tbl_sec_atr*) and the settlement (*tbSettlements*) tables, which are connected via the sector table (*tbl_sec*) and the link table *tbSettlementsSectors*. The type, phase, and

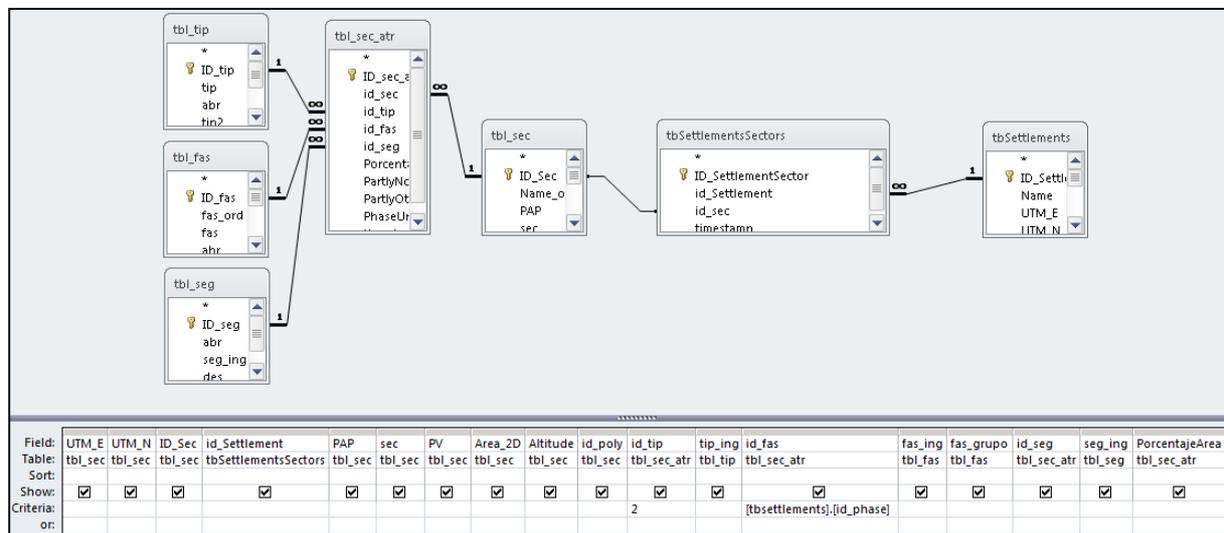


Figure 43: Design of the query in the settlement database combining fields from the settlement table, the sector table, and some related tables. This query was joined in the GIS with layers based on the polygon shapefile representing site and sector boundaries. This allows grouping and filtering of the polygons according to attributes stored in the database tables, especially the assignation of sectors to settlements. The settlements can further be represented by point markers which are placed according to the settlements coordinates and which depend in size on the population size and in form on the status class (Figure 44). Graphic: VS.

¹⁰¹ The georeferencing of Google’s imagery is not accurate either and may lead to offsets of more than 10 meters. This error is nevertheless acceptable, because the site delimitations are only rough estimates. More accurate imagery is offered by Esri as an online layer, which can be included to any ArcGIS® project. Currently, the highest resolution is only available for the lowermost part of the study area (Esri n.d.). This may be updated soon.

reliability tables on the left only provide the “real names” corresponding to the *id_numbers* of the respective attributes stored in the *tbl_sec_attr* table. This makes life easier when designing definition queries for layers in the GIS, because it does away with the need to constantly look up which ID represents which category. The query is limited to sites and sectors that include domestic occupations (the respective type ID *id_tip* is 2).

The link of this query to the polygon layer in the GIS was established via the sector ID (*ID_Sec*), using the join option in the context menu of the respective GIS layer. As a result, the non-spatial attributes of each sector could be derived from the database and did not have to be stored in the static attribute table of the shapefile (Figure 43). The greatest advantage of this linking lies in dynamic updating: whenever data – such as size or status classification – is altered, added, or deleted in the database, the connected GIS layer also updates automatically when refreshing the view.

For each phase three polygon layers were created with the filter (definition query) set to the corresponding phase name (Figure 44):

- One layer shows the reliability of the domestic character and the phase assignment using the *Unique values* symbology based on the reliability field. The four possible states of reliability are symbolized with thin black hatches (diagonal or cross hatches).
- A second layer indicates the percentage of the sector area assigned to a settlement using *Quantities* → *Graduated colors* to group the numeric values in the area percentage field into five classes and to draw grey hatches whose thickness depends on the percentage value.
- In a third layer all sectors belonging to the same settlement are grouped and painting in the same color via the *Unique values* option on the *Symbology* tab using the settlement ID (*ID_settlement*) as value field.

Additionally, a marker symbol layer represents the combined size and status classes of the settlements: the marker type depends on the status classification, and the symbol size depends on the

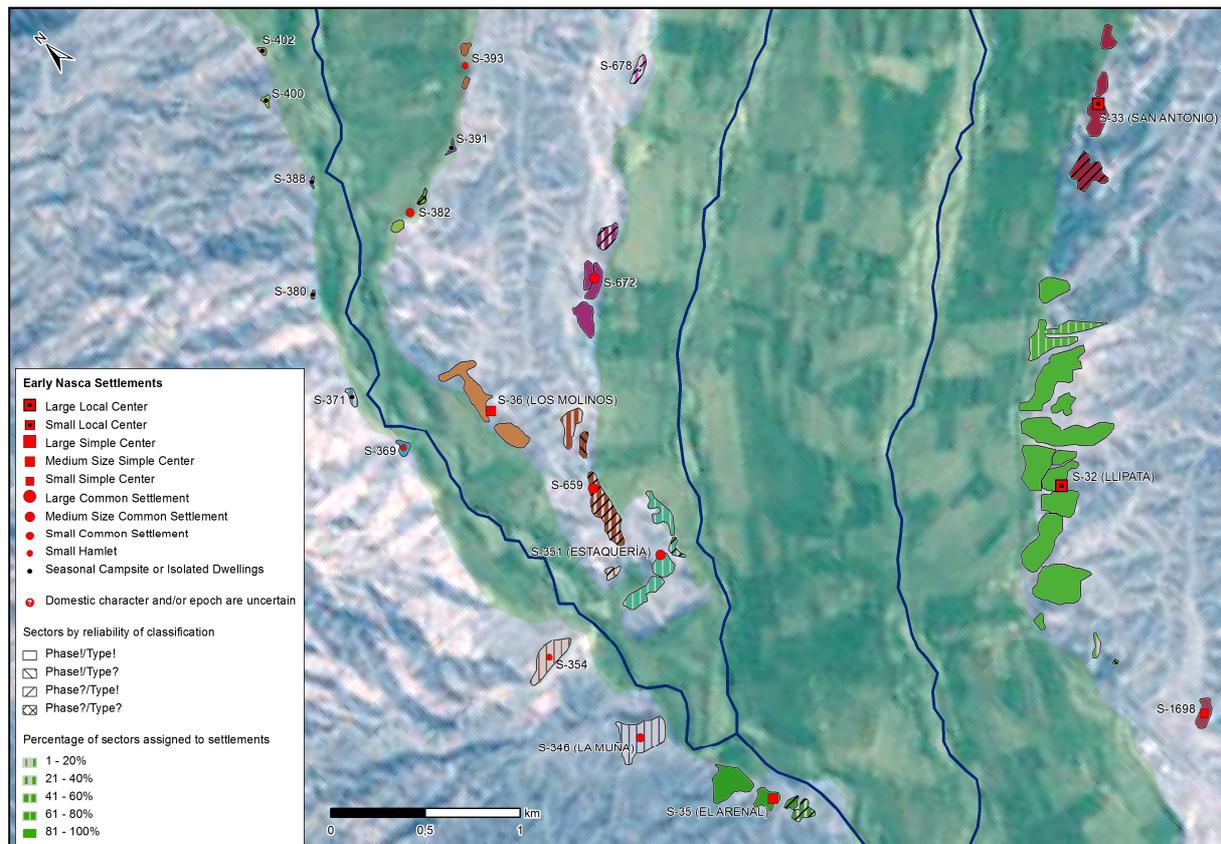


Figure 44: Detail view of Early Nasca settlements south of the town of Palpa. The marker symbols depend on the status class and their size on the population size class of the settlement they represent. All site sector polygons assigned to the same settlement are displayed in the same color. The vertically hatched gray overlays indicate the percentage of each sector's area that has been assigned to the respective settlement while the diagonal thin black hatches indicate whether the domestic character and the phase assignment can be regarded as reliable. Graphic: VS.

population size. By combining the four layers in a map, all essential information on settlement classification, extent, and spatial distribution becomes easily recognizable (Figure 44). During the process of data revision and quality checking, the GIS also facilitated the finding of errors and inconsistencies that cannot be detected easily by automatic algorithms, such as incorrect settlement-sector assignments, etc.

5.4.2 Distribution Maps

The spatial distribution of settlements can best be illustrated on maps. The settlement pattern maps set up for the present study are designed to show the whole study area on an A4 page at a scale of 1:300,000. Only marker symbols are displayed because the site sectors are not well recognizable at scales exceeding 1:60,000.¹⁰² These maps nevertheless provide a good visual impression of spatial distribution. For a better page fit, they are not orientated north but northeast. As mentioned before, the projection is always UTM, 18S with the spatial reference WGS84.

In the description and discussion of the maps, it is often necessary to refer to certain sections of the study area, e.g., to particular valleys or altitudinal ranges. For a quicker reference, I subdivided the study area into 13 sections displayed on Map 9. These divisions are purely technical and arbitrary and do not constitute analytical units. The lowermost section reaches from the confluence of the Río Grande and Ingenio rivers up to the point where the Río Grande valley has its narrowest spot. Above, the Palpa and Viscas rivers join the Río Grande. All three rivers have formed the great floodplain that ends northeast of Palpa and north of the Río Grande-Palpa confluence. Further upstream, each of the three valleys and the adjacent slopes up to roughly 2000 m.a.s.l. was further subdivided into middle and upper sections. The *cabezas*, largely corresponding to the altitudinal range between 2000-4000 m.a.s.l., were split vertically into four sections named after the principal modern villages: Huac Huas, Llauta, Laramate, and Ocaña. Since most *cabezas* settlements were located high above the valley floors, the area was divided along the river courses and not along the major ridges as had been the case at the foothills. Finally, another unit, referred to as *puna* de Llamocca, comprises the uppermost area at the foot of Cerro Llamocca.

For each phase, a “classical” distribution map was generated on which all settlements with the respective chronological classification are represented by red marker symbols. Additionally, those settlements which could only be assigned to a period in general appear on the maps for all phases belonging to that period but are shown as grey symbols.

In the case of the Wari and Ica phases, settlements with an undoubtedly late component, evidenced by the presence of Middle Horizon 2 and Inca style architecture and material, respectively, are marked in yellow. They are not shown on a separate map, because many of the other settlements, where no such evidence was found, may nevertheless have been occupied simultaneously. The lack of Wari or Inca remains can be explained by ethnic or cultural differences, since a coexistence of locals and immigrants from the distant Central Highlands is probable. Isolating the settlements clearly occupied by Wari or Inca people would create a false impression of low settlement density during the respective phases.

By comparing successive phases, significant changes in population density in different parts of the study area should become apparent. Furthermore, the distribution of important centers is displayed and uninhabited buffer zones between possibly competing dominions can be identified. For such interpretations it must be assumed, however, that all settlements shown on the same map actually existed *simultaneously*. At this point, the same problem comes into play which has already been discussed for the reconstruction of population development in Chapter 5.3: the longer a phase lasted, the fewer villages assigned to it will actually ever have coexisted at exactly the same moment. Since some will have been abandoned early and others established late, there is a high risk of assuming relations, particularly of hierarchical nature, between settlements that in reality were never occupied concurrently. Regarding spatial distribution, the situation at the beginning of a phase may have been markedly different from its end due to important developments during its course. This phenomenon cannot be recognized if all settlements with the respective chronological classification are lumped on the same map.

¹⁰² High-resolution maps displaying all four layers (including formatted the sector shapes) are provided in the “A1_Maps_SettlementsPerPhase” folder on Supplement DVD 1.

The problem can be dealt with to a certain degree by relying on the same principle introduced in Chapter 5.3: by regarding the phase transitions. Distribution maps representing only the settlements occupied at the respective phase transitions show settlements which actually were in use concurrently. They are hence much more reliable than the maps on which all domestically used sites assigned to a phase are lumped and they give a more realistic impression of settlement density and possible hierarchical relations. This approach requires determining if there were direct precursors or successors for each settlement. Handling individual settlements, however, is much trickier than calculating general statistical values like the summed up area.

A settlement is regarded as preceding another if both share at least one site sector. The problem is that a settlement may have had not only one but several precursors or successors assigned to different population and status classes. For example, a small village and a small hamlet spatially separated from each other may have grown together in the next phase to form a major settlement when the space between them was used for house construction. In turn, a major settlement may be largely abandoned while two sectors at the extremes remained occupied, now forming two independent small villages. In such a case, the question is raised, how the situation was at the phase transition. The population and status class at the transition point likely correspond to the state registered for the earlier occupation(s) if population or status were increasing and to those of the later occupation(s) if they were decreasing. This is because the preserved remains of a phase tend to reflect the *maximum* extent and status, even if these declined again in the course of that phase. If a large settlement had several smaller precursors of different population and status classes, then the one with the highest class was considered.

According to these presumptions, a VBA function was written that automatically determines all settlements existent at a phase transition as well as their likely population and status classes at this moment and saves the results to a separate table (*tbSettleTransitions*).¹⁰³ This table can be integrated into the GIS to generate pattern maps for the respective phase transitions. These maps will form the principle basis for most interpretative approaches concerning spatial distribution, although the classical distribution maps are also provided for comparison. They show all settlements assigned to a phase including those without direct precursors or successors, which do not show up on the phase transition maps. All maps are presented in Chapter 6.

5.4.3 Relative Distance and Altitude Calculations

Distance, in absolute and in relative terms, is the basis of any spatial analysis and can be measured in a number of ways: length of geodesics, along a curved path, or in time necessary to walk, ride, or drive from A to B. For the present analyses of settlement patterns, two distance indications are important:

- 1) The distance to the coastline as indicator for a more foothills- or more *cabezadas*-oriented location of a settlement.
- 2) The altitude relative to the surrounding landscape as an indicator for a possibly defensive hilltop or ridge position.

Topography is essential not only for the determinations of the relative altitude but also for the calculation of the distance to the coastline. In daily life, it is often more important to correctly estimate the necessary time investment than to know distances in spatial units. Geodetic distances can be misleading, because obstacles like rivers, swamps, and dense forests can crucially constrain the passage. As vegetation at the desert margin is sparse and the rivers can easily be waded across most of the year, these obstacles are negligible for the study area. The pronounced relief of the mountainous terrain, in turn, has to be considered because a short way along a steep path may take much more time than a long one crossing even ground. In the particular case of the study area, it seems acceptable to calculate potential travel speed and time investment for movements as a function of slope alone,

¹⁰³ The function was not run on the 20 settlements which could not be assigned to a phase, because there is no sense in looking for a precursor or successor when it cannot even be said whether the settlement was occupied at the beginning or the end of a time span of 600-900 years. Accordingly, these 20 villages do not show up on the phase transition maps, either.

ignoring other factors. For topography-based distance calculations in the GIS, a digital elevation model (DEM) derived from ASTER data (1-arc-second resolution) was used.¹⁰⁴

Distance from the Coast Line

If the time investment necessary to walk from a settlement to the coast is to be calculated, a topography-dependent algorithm for walking speed is needed. Such an algorithm was proposed by Waldo Tobler (Tobler 1993). It has already been employed in other archaeology related studies (Fux et al. 2009, Jennings & Craig 2003). Tobler calculated walking velocity (W) in km/h as

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

where S is the tangent of the slope angle (Tobler 1993, cf. Figure 45).

ArcGIS® provides a tool for the calculation of a slope raster from a DEM with the output values given either in degrees or in percent. With Tobler's algorithm, another raster can be derived from the slope raster, which indicates the possible hiking velocity with which each cell can be crossed. For this purpose, the ArcGIS® *Raster Calculator* (Map Algebra) can be used. Since the Abs function in ArcGIS® needs the slope angle in radiant units rather than degrees, the variable S in Tobler's formula has to be transformed to:

$$S = \text{Tan}(2\pi * [\text{slope angle}^\circ] / 360^\circ)$$

As the *Raster Calculator* has no π -constant, 2π has to be replaced by the approximate value 6.28. If "Slope.tif" is the name of the slope raster, the complete algorithm should look like this in the *Raster Calculator*:

$$6 * \text{Exp}(-3.5 * \text{Abs}(\text{Tan}(6.28 * \text{"Slope.tif"} / 360) + 0.05))$$

The result will be a speed raster, indicating the hiking velocity for each cell in km/h.

For the calculation of time investment the inverse values have to be generated in order to get h/km instead of km/h. As ArcGIS® often crashes or behaves unexpectedly when handling large floating point rasters, it is recommendable to choose small units, like hundredths of a second per meter (hs/m) instead of h/km, and then round the values to integers: $1 \text{ h/km} = 360 \text{ hs/m}$. In order to limit computing time for further operations, a maximum value should be fixed that replaces all values exceeding it. Since cells that require more time investment than 36 seconds to cross a meter (which corresponds to a velocity of less than 0.1 km/h) can be treated as not traversable, a maximum value of 3600 hs seems adequate. The whole formula to be inserted in the *Raster Calculator* combining all these conditions looks like this:

$$\text{RoundUp}(\text{Con}(\text{Power}(6 * \text{Exp}(-3.5 * \text{Abs}(\text{Tan}(6.28 * \text{"Slope.tif"} / 360) + 0.05)) / 360, -1) < 3600, \text{Power}(6 * \text{Exp}(-3.5 * \text{Abs}(\text{Tan}(6.28 * \text{"Slope.tif"} / 360) + 0.05)) / 360, -1), 3600))$$

The Tan function (yellow) corresponds to the S variable in Tobler's equation as explained above while the Power function (red) indicates an exponent for the basic algorithm (bold). As the desired output values are the inverses, the exponent is given as -1. The Con function (blue) constitutes the condition that in the resulting raster all values higher than 3600 will be set to 3600. Finally, the *RoundUp* function (grey) rounds the values to the next highest integer. The outcome is a time investment raster, indicating how many hs it will take to cross 1 m of the respective cell (Figure 46).

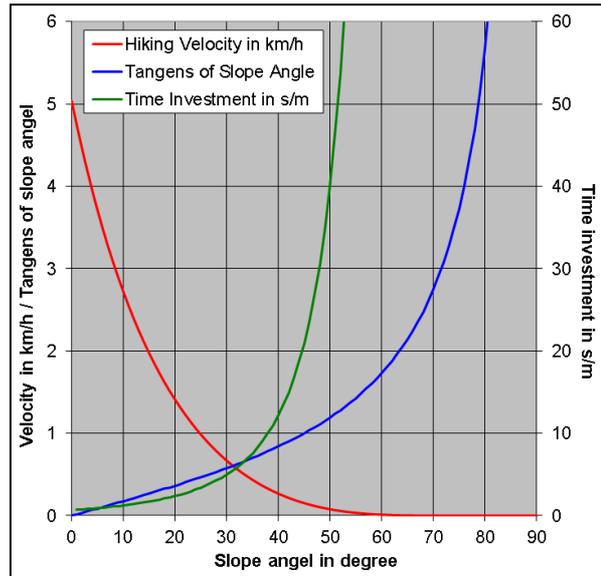


Figure 45: Dependence of hiking velocity and time investment on slope angle according to Tobler's algorithm. Slopes steeper than about 50° would slow down hiking speed to less than 0.1km/h and would require a time investment of more than 40 s/m (= 11.11 h/km). These areas can be regarded as not traversable. Graphic: VS.

¹⁰⁴ The Advanced Spaceborn Thermal Emission and Reflection Radiometer (ASTER) is a sensor on board of the Terra satellite and works since 2000. It uses electro-magnetic waves to measure surface elevations. The Digital Elevation model derived from the ASTER data is available for free at <http://gdex.cr.usgs.gov/gdex/>.

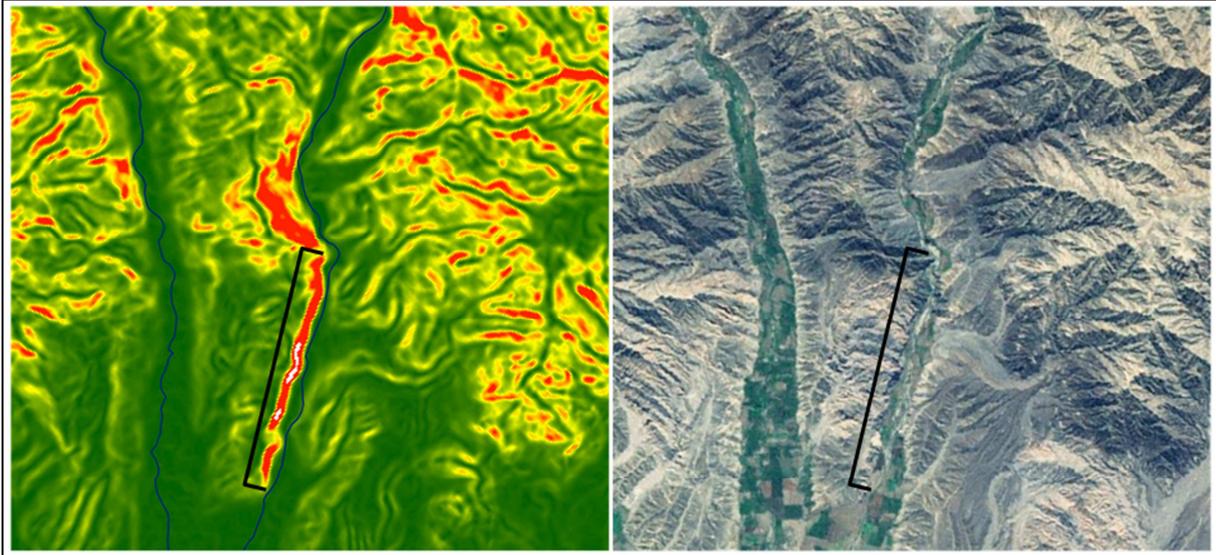


Figure 46: Time Investment for crossing a certain terrain calculated as a function of slope. The picture shows the region around Cerro Carapo which divides the Palpa and the Viscas valleys. The green areas can be crossed rapidly while the red ones require a lot of time to pass through. The white cells represent terrain regarded as not traversable. When travelling from the Palpa to the Viscas valley, it might be faster to make a detour to southerly circumnavigate the ridge than directly crossing it. The steep right margin of the Viscas valley constitutes a major natural obstacle compared to the other valley margins. Graphic: VS.

Even though all resulting values will be integers, ArcGIS® still produces a 32-bit floating point raster. It can be converted to a 16-bit unsigned integer raster with the *Copy Raster* tool. This will save disk space and increase processing speed in further operations. The tool also allows indicating a value that will be set to NoData. In this case, the value should be 3600 as the corresponding cells are regarded as not traversable and can be excluded from distance calculations.

Another raster can now be created that indicates for each cell the time investment necessary to reach the closest point along the coastline by foot. This can be done using the *Cost Distance* tool. The input data should be a line shape representing the coastline while the time investment raster just created will represent the cost raster (Figure 47). The output will be a 32-bit floating point raster with cell values given in hundredths of seconds. A division of the cell values by 6000 will change the unit from hundredths of seconds to minutes. It is highly recommendable to round the values to integers in the *Raster Calculator*.

The new cost-distance raster can now be used to determine the time distance from the coast of each site sector. Via the *Add XY Data* menu entry in ArcMap®, a point layer based on the UTM coordinates stored in the sector table (*tbl_sec*) can be created in the GIS. This layer was exported to a static shapefile, which is necessary for the use with most analytical GIS tools. With the *Add Surface Information* tool, each point was assigned the value of the cell of the distance raster it falls in. This value was added to the respective record in the attribute table of the point shapefile and could then be copied back to the sector table in the database. The distance values for each settlement were calculated as the averages of those for all site sectors assigned to it.

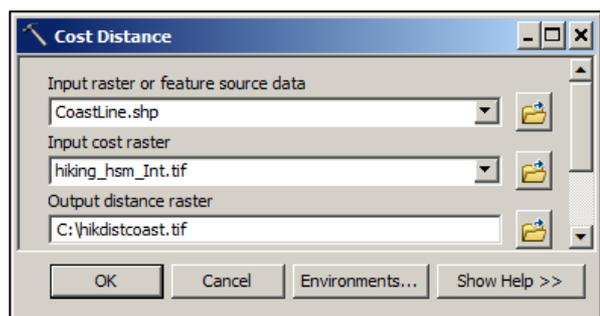


Figure 47: Calculation of a cost distance raster indicating for each cell the minimum walking time necessary to reach the closest point along the coastline. Graphic: VS.

Altitude above Valley Floor

The altitude of settlements relative to the valley floor is another interesting aspect. Many villages are located immediately at the valley margins while others are located at hilltops, on ridges, or on steep slopes. The former provide easy access to river water and to cultivated fields while the latter offer a good panoramic view and are generally easier to defend. A high percentage of settlements located in

defensive positions can be expected in times of conflict but this has to be checked against the general archaeological evidence. If at the same time features like surrounding walls and sling stone deposits increase in frequency, then it is very likely that the choice of settlement location followed security considerations. At the *cabezadas*, however, the major part of the cultivated fields could not be found at the narrow valley floors but on terraced slopes. In this area, not only defensive considerations, but also the proximity to these terraces may have been a principal motivation for placing villages at elevated locations.

Whether a settlement's location can be considered elevated does not depend on its absolute altitude but on its position relative to the surrounding landscape. Since a visit in the field will give a subjective impression whether a certain place is defensive or not, field studies are surely much more reliable than any GIS analyses for the detailed treatment of a particular site. For the comparison of hundreds of sites, however, some kind of objective numeric standard is desirable.

Bertil Mächtle (2007) solved the problem by calculating the difference between the altitude of the center of a site and the altitude of the nearest point along a river course, which is normally the deepest point in a site's neighborhood. The approach works reasonably well at the foothills where most sites, especially those including settlement remains, are located at the valley margins close to the major rivers. As a rough orientation, a relative altitude above 50-100 m indicate a defensive position at least at the foothills, being that almost all settlements with additional walls and sling stone deposits can be found at such heights (or higher). Lesser altitude differences between the lowest point in the valley and the center of the settlement are often accountable to a smooth ascending of the valley floors towards the margins and not to steep slopes providing protection.

The extension of the study area towards the highlands requires a refinement of Mächtle's approach. In the *cabezadas* some villages lie on vast and easily accessible, elevated plains, several hundred meters above the major streams but also many kilometers away from them. In these cases, the long distance disqualifies the rivers as a suitable reference because they no longer represent the immediate neighborhood. In order to limit this source of error to a minimum, not only the major rivers but also small lateral *quebradas*, which may not even carry water, should be considered. The finer the ramification of the stream network the higher the probability that a reference point is found relatively close-by that actually represents the lowest location in the immediate neighborhood of a site.

For this reason, the streams were newly calculated from the ASTER DEM with the ArcGIS® Hydrology toolset. First, a flow direction raster was derived with the *Flow Direction* tool, which then served to calculate a flow accumulation raster with the *Flow Accumulation* tool. In this raster, each cell is assigned a value corresponding to the number of cells flowing into it. If the smaller values, which correspond to either hilltops or flat areas, are set to Null, the remaining ones will represent the actual stream network. It will represent even the tiniest runlet, making it hard to identify the more important streams. It is therefore recommendable to set all cell values smaller than a specific minimum value to Null. In this case, a minimum value of 50,000 was considered appropriate. The outcome was a still finely ramified stream raster showing not only the major rivers but also the small and generally dry *quebradas*. With the *Raster to Point* tool, this raster was converted to a point shape. Each point represents the center of a cell with a value other than Null. With the *Add surface information* tool, each point was given the altitude of the DEM cell it falls in as an additional attribute. This shapefile could now serve as reference for the calculation of the altitude of sites and sectors relative to the valley and *quebrada* floors. Thanks to the integration of minor drains, the nearest reference point for each sector in most cases lies acceptably close to it at a distance of no more than 2.2 km and of about 500 m

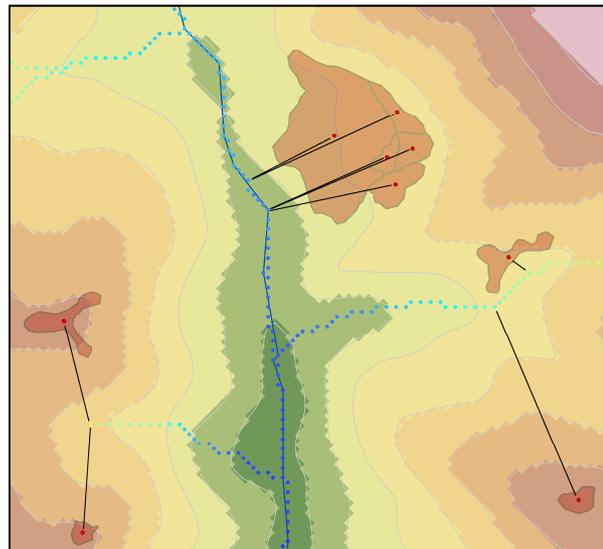
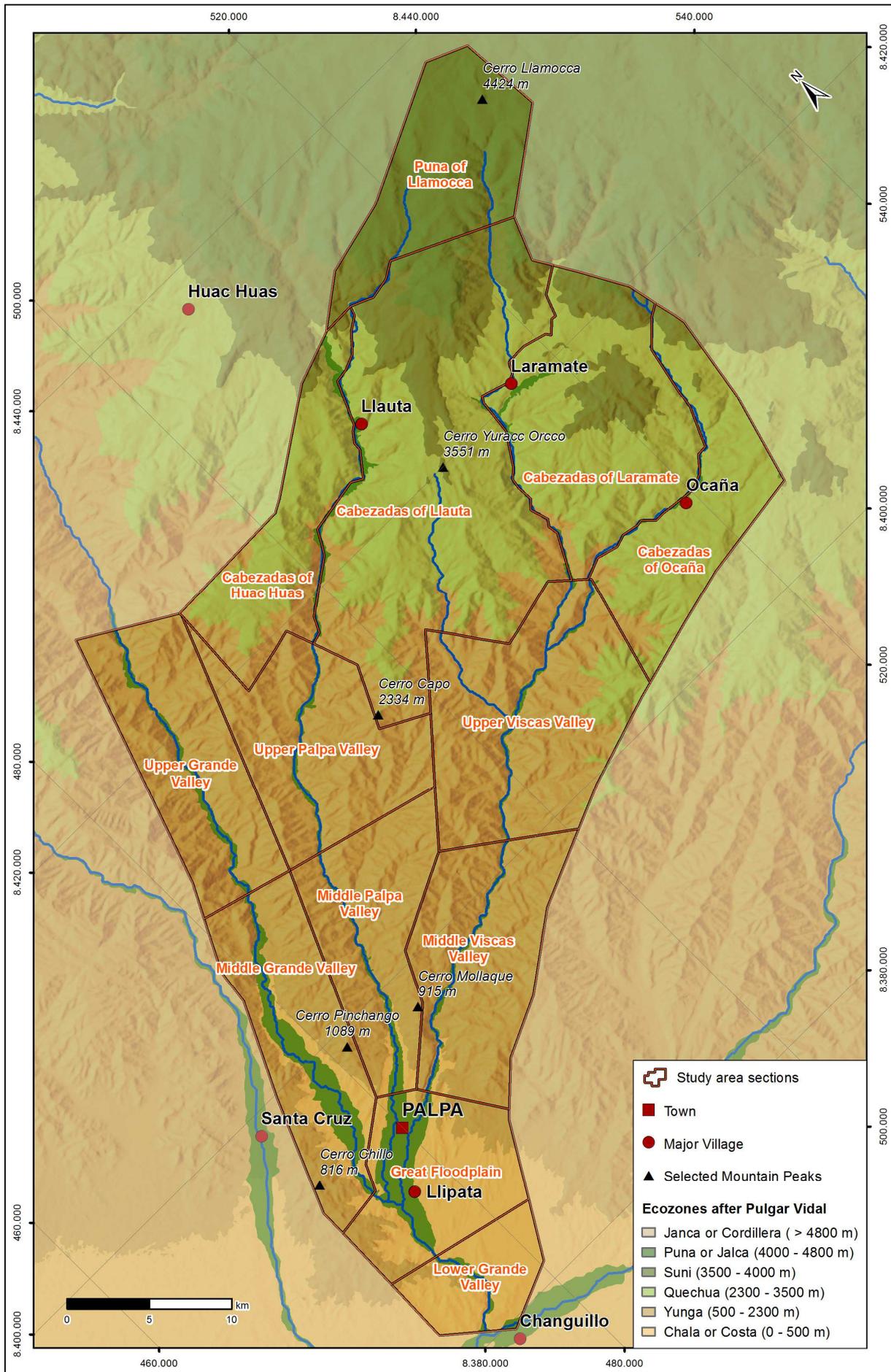


Figure 48: Calculation of the altitude above valley floor level: The red points represent the centers of the site sector shapes (irregular red areas). The blue dots are the ones derived from the finely ramified stream raster which also shows small lateral gullies draining into the major river (blue line). Both point shapes are assigned the altitude values of the DEM raster cell they fall in. The difference of the altitudes of a sector center and the blue point closest to it (indicated by black lines) is considered the sector's altitude above valley floor level. Graphic: VS.

on the average (Figure 48).

Finally, the point layer, which had been created for the calculation of the distance from the coastline and which already contained the sector altitude, was joined (based on spatial location) with the new point layer representing the valley floors. By doing so, for each sector point the altitude value of the closest valley floor point was added to the respective record in the attribute table. The difference between the altitude values of each sector point and the closest valley floor point were then calculated in a separate field, which had been added to the attribute table.



Map 9: The study area in the northern part of the Río Grande de Nasca. The area is divided into 13 sections in order to ease geographic orientation. Map: VS.

6 Results: Diachronic Settlement Patterns, 1500 BCE-1532 CE

The analyses carried out with the methods and approaches explained in the previous chapters bore a variety of interesting results concerning the particularities of the settlement patterns from the Initial Period until the Late Horizon. After some comments on general observations concerning architecture and spatial distribution of certain classes of settlements, these results will be presented in this chapter ordered by chronological phases. Following a short introduction into general developments during a phase, including its temporal delimitation and the number and size of assigned settlements, a section about common architecture and layout patterns will follow, including a description of representative cases. For most phases it is useful to distinguish between foothill and *cabezadas* villages, because architecture and settlement layout were markedly different in these two areas. The spatial distribution of villages and its possible implications on land use and subsistence strategies will be outlined thereafter. A third section treats apparent status differences between villages and the presence or absence of defensive measures in order to deduce settlement hierarchies and the degree of political unification or competition. Finally, inter-phase developments will be addressed by comparing settlement patterns at phase start and phase end.

For a correct understanding of the statements made in this chapter, please note the following remarks:

- The basic information on settlements of the same phase is summarized on sheets containing the numeric data (Chapter 5.2.5), on xy-scatter diagrams illustrating relative heights and distances (Chapter 5.4.3), and, of course, on distribution maps (Chapter 5.4.2).
- Unless indicated otherwise, numeric dates and phase lengths mentioned in the text refer to the most likely values according to the current chronological model (Chapter 5.2.2.2). Likewise, all mentioned values derived from phase length, e.g., the annual growth rate, were calculated on the basis of the likely phase lengths. Error ranges are given on the statistics sheets.
- Settlement numbers and areas and derived values include settlements where the chronological position and/or the domestic character of the occupation are uncertain. Alternative figures excluding all cases not reliably classified are listed on the sheets.
- When presenting the shares of the individual population and status classes in the text, the percentages refer to the total settlement *area*, not to the number of settlement.
- On the distribution maps, only settlements mentioned in the text are labeled. Completely labeled high resolution maps can be found in the "A1_Maps_SettlementsPerPhase" folder on Supplement DVD 1.

6.1 Basic Architectural Features

Despite the many changes and developments during the 3,000 years of history studied in this work, certain architectural traditions show an impressive longevity and persist even until today. In order to avoid repetition when presenting results phase by phase, first a brief overview of basic architectural features shall be given.

Three basic types of building material were employed throughout the millennia: stone, *quincha*, and *adobe*. Widely used types of stones are undressed, angular fieldstones and round riverbed cobbles, ranging in dimensions from about fist size to more than one cubic meter (Figure 49d-h). *Quincha* is the typical coastal Andean variant of wattle-and-daub construction. Between strong wooden trunks at the corners (usually from the *huarango* tree), riverine reed, sometimes in bundles, is braced by two or three horizontal stems and daubed with clay (Figure 49c). *Adobes* are unfired mud bricks which come in a variety of shapes (Figure 49a/b). They constitute an astonishingly weather-resistant construction material under dry conditions that is readily available in most areas. If not protected by a roof, however, *adobes* are gradually washed away in regions with strong seasonal rainfalls, like the *cabezadas*.

Both free-standing and retaining walls come across in a single- and a double-face variant. In the latter case, both faces are often slightly inclined towards the interior and the space between them is filled

with earth and gravel. When built of stones, these are usually arranged in a way that the flattest side faces outward (Figure 49h) while conical *adobes* expose their round or oval bases (Figure 49b). In single-face walls, stones may be united with earth mortar or just fitted together as a drystone construction, called *pirka*.

On uneven terrain, buildings were usually erected on construction terraces. These can be strictly rectangular, especially when fulfilling representative functions, but in most cases they just follow the natural contour lines. When a terrace was constructed, first a retaining wall was built. Afterwards, material above the level of the coping was carved out of the slope and heaped against the wall until the space between it and the natural slope was completely filled. As a result, the filled-up and the carved-out sections formed a single level surface (Figure 49e). The retaining walls occur in the single- and the double-face variant and were mostly built of stone, although in the foothill area, *adobe* was also employed in some cases. Some terraces were not intended to support a building but to form large open platforms, presumably for communal activities.

At the foothills, the typical dwellings of the commoners were either small, rectangular *quincha* huts or stone houses of different and often irregular but overwhelmingly angular shapes. Sometimes, only low base walls were constructed that were complemented with higher-reaching, thick *quincha* walls on the inside. In these cases, generally only the stone lines are visible on the surface, but excavations often revealed rests of the *quincha* constructions as well (Figure 49d). Special buildings and elite residences usually had a strictly rectangular layout and their walls were completely made of *adobes* or stones. Roofs are rarely preserved, except some fragments found in terrace fills which might once have formed part of a roof of an older hut. *Quincha* houses built today show a flat roof, also made of *quincha*, but supported by wooden crossbars and covered by a layer of mud. The archaeological remains known so far seem to support the notion that pre-Hispanic roofs were built alike.

In the *cabezadas* and the upper valleys the common shape for buildings is round, but not necessarily circular. The only exceptions are some rectangular administrative buildings erected by non-native Wari and Inca people. Virtually all types of construction were built of stone, although some walls may originally have had an upper section of *adobe* which has long been washed away and is not recognizable any more. On steep terrain, dwellings often incorporate the retaining wall of the terrace behind them as a back wall and there cannot always be made a clear distinction between terrace and building walls (Figure 49f). Where preservation is good, sometimes patio groups can be observed where the entries of several neighboring houses face towards the same open space. Since these patios can have enclosure walls and roofs are not preserved, it can be difficult to distinguish a small patio from a large house. Drawing again on present-day examples, it can be assumed that roofs were made of cactus trunks covered with thick layers of straw and grass (Figure 49g). Only the burial houses (*chullpas* and *kuntis*) had roofs of stone slabs, sometimes of considerable size.

Especially on the high elevation plains of the *puna* and the upper *cabezadas* large enclosures of single-face drystone walls (*pirka*) can be found. These are interpreted as pens for camelids. Smaller exemplars are also present at a few foothill settlements where they may have served to keep some livestock intended for slaughter or the llamas of by-passing transport caravans. It is also possible that some of these constructions were no pens at all but fences intended to keep browsing animals out of house gardens.

6.2 Spatial Settlement Distribution by Size and Status Classes

A clear relation can be observed between settlement size and location (Map 10). Population centers were the foci of settlement activity where probably hundreds of people concentrated, and in some cases perhaps even more than a thousand. They were generally located close to the agriculturally most productive areas, which are the floodplains at the foothills and the dark soil belt at moderate altitudes in the *quechua* ecozone. Only a few of these places could have housed a good part of the overall population in a given phase. In most cases, it seems likely that the function of these settlements was not limited to dwelling alone but that elite members with administrative powers resided here. Additional clear indicators for such a status, such as prominent architecture, are sometimes hard to identify.

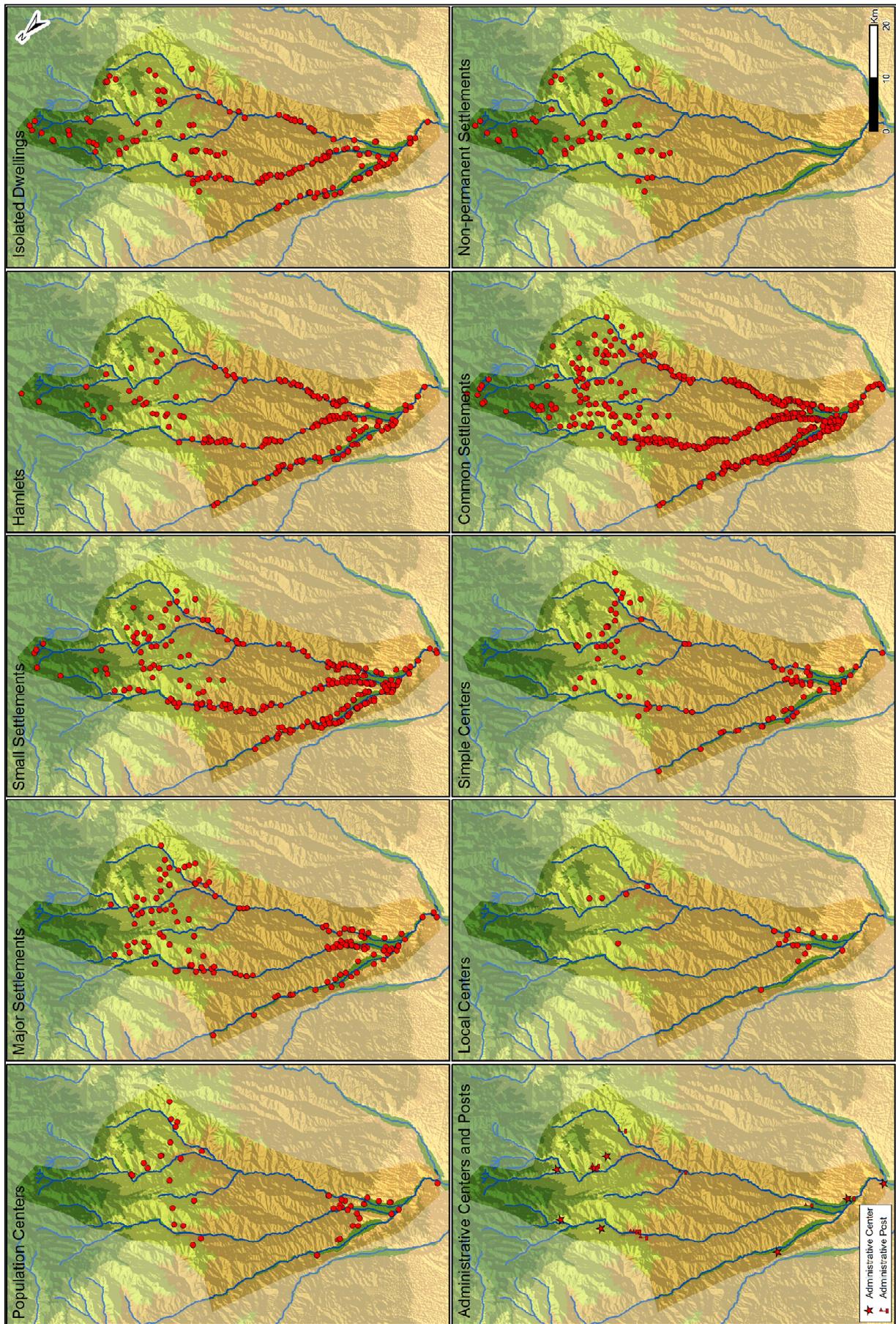
Major settlements and small settlements were much more common. While most of these places consisted only of simple dwellings, some major settlements show very careful elaboration and archi-

tectural features that hint to administrative functions and the presence of elites. Like the population centers, major settlements were concentrated in the most fertile areas, but a number of them can also be found in the more marginal middle sections of the river valleys. Small settlements, in turn, can be found throughout the study area.

Small hamlets are almost exclusively simple minor dwelling sites. They, too, can be found everywhere, but they are especially common in the narrow middle valley sections. Probably only one or two extended families lived at these places. Isolated dwellings are either tiny and very simple settlements or they form part of large sites predominantly consisting of non-domestic structures, particularly pens and agricultural terraces. In the latter cases they can be interpreted as herder or farmer huts and were possibly only seasonally occupied when livestock was driven to pasture lands or when less important remote fields had to be worked. Isolated dwellings can therefore also be found at extreme altitudes and in areas with a low agricultural potential. In most cases, less than 10 persons will have lived at a time in this kind of settlement.



Figure 49: Long-lasting architectural traditions: a) piled up cubic mud bricks (adobes) next to a modern house built of this material, b) an ancient (Middle Nasca) wall constructed with conical adobes at La Muña (PAP-79), c) abandoned contemporary wattle-and-daub (quincha) hut, d) remains of ancient (Middle Ica) quincha walls protected on the outside by low stonewalls at Chillo (PAP-396), e) contemporary cut-and-fill retaining terrace preventing erosion and providing a level construction ground, f) an ancient (Late Paracas) double walled stone house using the adjacent terrace as back wall at Quechqalla (PAP-770), g) a contemporary shepherd's round stone hut with a conical roof of grass and dry cactus trunks, h) exceptionally well-preserved ancient (Late Ica) freestanding double-walled round stone house at Santa María (PAP-788). Photo d): Palpa Project, all other photos: VS.



Map 10: Spatial distribution of settlements of all phases differentiated by status and population size classes. Maps: VS.

6.3 The Initial Period (IP)

The earliest ¹⁴C-date for the Initial Period (IP) from the study area is 1460 BCE (Unkel et al. 2012). Until now, no site registered by the Palpa Project shows an occupation dating to the time span between the abandonment of the archaic settlement at Pernil Alto around 3000 BCE and the IP occupation at the same location about 1500 years later. The beginning of the Initial period therefore is still in the dark. It ends with the emergence of the Paracas culture in the 9th century BCE, likely around 840 BCE. This long time span of about 660 years is a problem when regarding settlement patterns. The probability that most of the settlements assigned to the IP having been occupied sequentially rather than simultaneously is high. This makes plausible statements about distribution, hierarchies, and population dynamics difficult. Furthermore, the oldest occupations have the highest chance of being destroyed, buried, or completely overbuilt during later phases. Therefore, it is almost certain that a substantial number of IP settlements are completely covered and were thus never registered, or simply do not exist anymore.

Fourteen IP settlements with a total extent of 6.9 ha were documented in the study area. Their average size of only 0.49 ha is significantly smaller than that of later phases. Two villages were classified as isolated dwellings and seven as small hamlets making up 2.4% and 35.1% of the total settlement area. Only five villages can be regarded as small settlements but these comprise fully 62.5% of the total area (Figure 53).

6.3.1 Settlement Layout and Construction Techniques

The picture that can be drawn so far for the IP settlements at the foothills is predominantly based on excavations at Pernil Alto (Figure 50), but there were probably other similar settlements in the middle valleys and around the great floodplain which were buried or destroyed by later occupations and agricultural activity. S-460 at PAP-266 (Pernil Alto) lay on the right margin in the middle section of the Río Grande valley where the floodplain is relatively broad. This place was occupied in the Middle Archaic Period during most of the 4th millennium BCE and had then been abandoned for about 1600 years (Isla Cuadrado 2010, Unkel et al. 2012).¹⁰⁵ Reindel and Isla identified 5 phases of remodeling, extension, and overbuilding of the IP village, but the basic construction technique stayed the same: clumps of clay were used to construct the walls of the small, and agglutinating rectangular rooms, which were connected by narrow passages. The remains of *huarango* posts suggest that these rooms were most likely covered by light reed-thatched roofs. The floors consisted of compacted clay and were renewed several times. During the first phases, the central section of the settlement was surrounded by an enclosure wall (Reindel & Isla Cuadrado 2006/2009).

Highland oriented settlements located farther upstream show a different structure and organization. The IP occupations in the upper sections of the Palpa and Viscas valleys were mostly overbuilt or reused in the Early and Middle Paracas phases. Where earliest architectural remains are observable, it nevertheless becomes clear that construction techniques and settlement structure were basically the same in the IP as in the Early and Middle Paracas phases. S-1290 at PAP-1075 (Collanco) is such a case of long-term continuity. Here, the later Paracas occupation seems to have been less intense and it can be expected that much of the visible remains date back to the IP. In contrast to S-460 (Pernil Alto), the building material was not clay but unhewn fieldstone used to construct drystone walls (*pirka*) or single-face walls with clay mortar between the stones. The stones used were often of considerable size, exceeding 50 cm in at least one dimension. The shapes of the structures were predominantly round to oval, and sometimes irregular but very rarely angular. Dwellings typically had a diameter of between three and six meters and were placed on construction terraces. The surroundings were covered by low agricultural terraces (of uncertain construction date) with retaining walls made of differently sized stones.

At some other sites in the area with an IP component, large enclosures with up to 20 m in diameter are observable, which could represent either pens or gardens protected against browsing. Since neither agricultural terraces nor the enclosures can be dated confidently to the IP, these may also be constructions related to the Paracas occupations. No IP settlements have so far been documented at the *cabezadas*.

¹⁰⁵ The Archaic occupation of Pernil Alto is currently being investigated by Hermann Gorbahn in the scope of a PhD project.



Figure 50: The angular clay structures of S-460 at Pernil Alto. Photo: Palpa Project.

6.3.2 Settlement Location and Subsistence

As stated above, distribution patterns have to be handled with great care because of the long time span of the IP and the possibility that settlements might have been occupied sequentially. It can nevertheless be assumed that the upper section of the Palpa valley and probably as well of the Viscas valley around the 1500 m contour and at 20-24 hours of walking time to the coast were preferred settlement areas (Figure 51). From here, grazing and hunting grounds in the highlands and cultivated fields in the temperate *quechua* and the warm *yunga* were equally easy to reach. This factor would be especially important for groups with a mixed agricultural and hunting/foraging economy.

The relatively limited area of arable floodplain close-by was not a serious disadvantage. Since population density was low, only few fields had to be cultivated to meet the demands of the settlers. The lack of *cabezadas* settlements suggests that neither the cultivation of typical highland crops, such as quinoa or potato, nor camelid herding played a role in subsistence strategies. The economy seems to have been based on riverine and small-scale irrigation farming, and perhaps also on rain-dependent farming around the 1500 m contour in times of especially favorable climatic conditions with a strong shift of the desert margin towards the coast. According to the paleo-environmental studies discussed in Chapter 2.2.3, the climate during much of the IP should have been as dry as today, but after approximately 1000 BCE, a transition towards less arid conditions may have occurred.

Agriculture was well developed and played at least an important but probably a dominant part in the diet. At the site of Pernil Alto, a variety of different crops was still preserved due to excel-

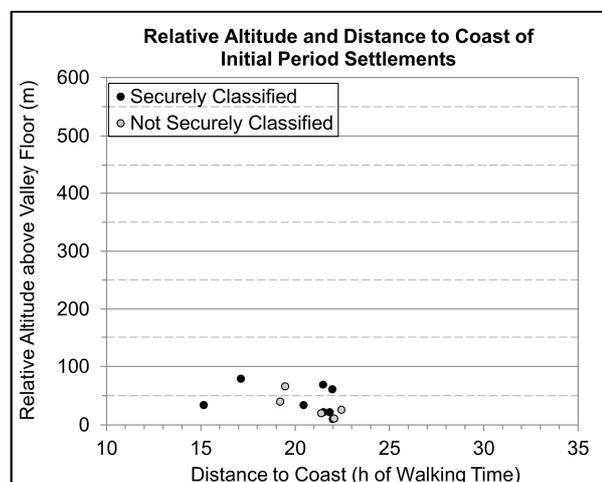


Figure 51: Relative altitude above the valley floors and walking time distance to the coast for all IP settlements. Graphic: VS.

lent conservation conditions, namely corn (*Zea mays*), lima bean (*Phaseolus lunatus*), common bean (*Phaseolus vulgaris*), giant bean (*Canavalia plagiiosperma*), sweet potatoe (*Ipomoea batatas*), yuca (*Manihot esculenta*), squash (*Cucurbita maxima*), calabaza (*Cucurbita moschata*), spaghetti squash (*Cucurbita pepo*), yam bean (*Pachyrhizus tuberosus*), bottle gourd (*Lagenaria siceraria*), peanut (*Arachis hipogea*), achira (*Canna edulis*), and chili pepper (*Capsicum sp.*). Fruits were also consumed, but were probably gathered rather than planted. Species found at Pernil Alto include pacay (*Inga feuillei*), common guava (*Psidium guajava*), and the edible siliques of the porknut tree (*Acacia macracantha*), locally known as *huarango* (Reindel & Isla Cuadrado 2009, p. 277). The use of irrigation systems other than simple short ditches is not likely at this time as the overall population level was still low and hence there was no need to extend the cultivated area beyond the largely self-irrigating riparian zones. Most of the valley floor was probably still covered by *huarango* forests offering good conditions for hunting and foraging. These complementing subsistence strategies may still have been more significant than they were in later phases.

Map 11 clearly shows that S-460 (Pernil Alto) was strategically located right in the middle of the extended (by then largely forested) floodplain of the middle Río Grande valley. The maritime resources of the coast at 15 hour walking distance could be reached in two days, even when carrying a burden of moderate weight. In 2009 I was able to do the hike in this time frame departing from Palpa. Slightly less time investment is needed to reach the *cabezadas*. Accordingly, although Pernil Alto's inhabitants presumably concentrated on riverine agriculture and forest foraging to complement their needs, they could reach all ecozones with their respective resources, except the *puna*, within two days. The upper valley villagers, in turn, would have had to invest another day to reach the shore and this will have made such trips less attractive for them. Instead, they can be expected to have made more intensive use of the *quechua*, *suní*, and *puna* zones, especially with respect to camelid and cervid hunting.

6.3.3 Hierarchy and Defensive Measures

Four of the 14 IP settlements lay more than 50 m above the valley floor but still well below the 100 m mark (Figure 51). In neither case is the location especially protected by the natural setting nor can any signs of fortification be found. Conflict does not seem to have been a major concern in those times. None of the IP settlements shows any features that could hint to a status superior to other villages. Except for one probably non-permanent village, all others can be classified as common settlements. Even if one of these clearly stood out, the question of contemporaneity, which affects the reconstruction of a settlement hierarchy, would still persist. There is little sense in discussing the center status of a settlement when the presumably subordinate villages may actually date to another subphase. Given the low population density and the abundant resources, people always had the option to move away if a neighboring clan tried to dominate them. Unlike the situation in the Norte Chico, there also are no recognizable large-scale community works like sophisticated irrigation systems or monumental architecture that would require a certain degree of organization and administration. In sum, the IP society in the study area probably lacked any formal political organization beyond the village community level, which does not exclude the existence of kinship and exchange relations between neighboring and distant settlements.

6.3.4 Major Inter-Phase Developments

Due to the lack of data on Late Archaic settlements a comparison of the IP settlement patterns to those of the previous phase is not possible. In general, the remains of the earliest of the phases considered in this study are likely the less preserved and most incomplete. Although it is probable that many IP settlements have disap-

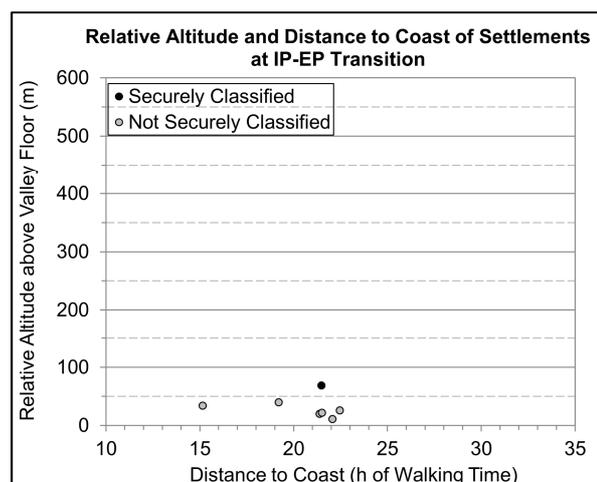


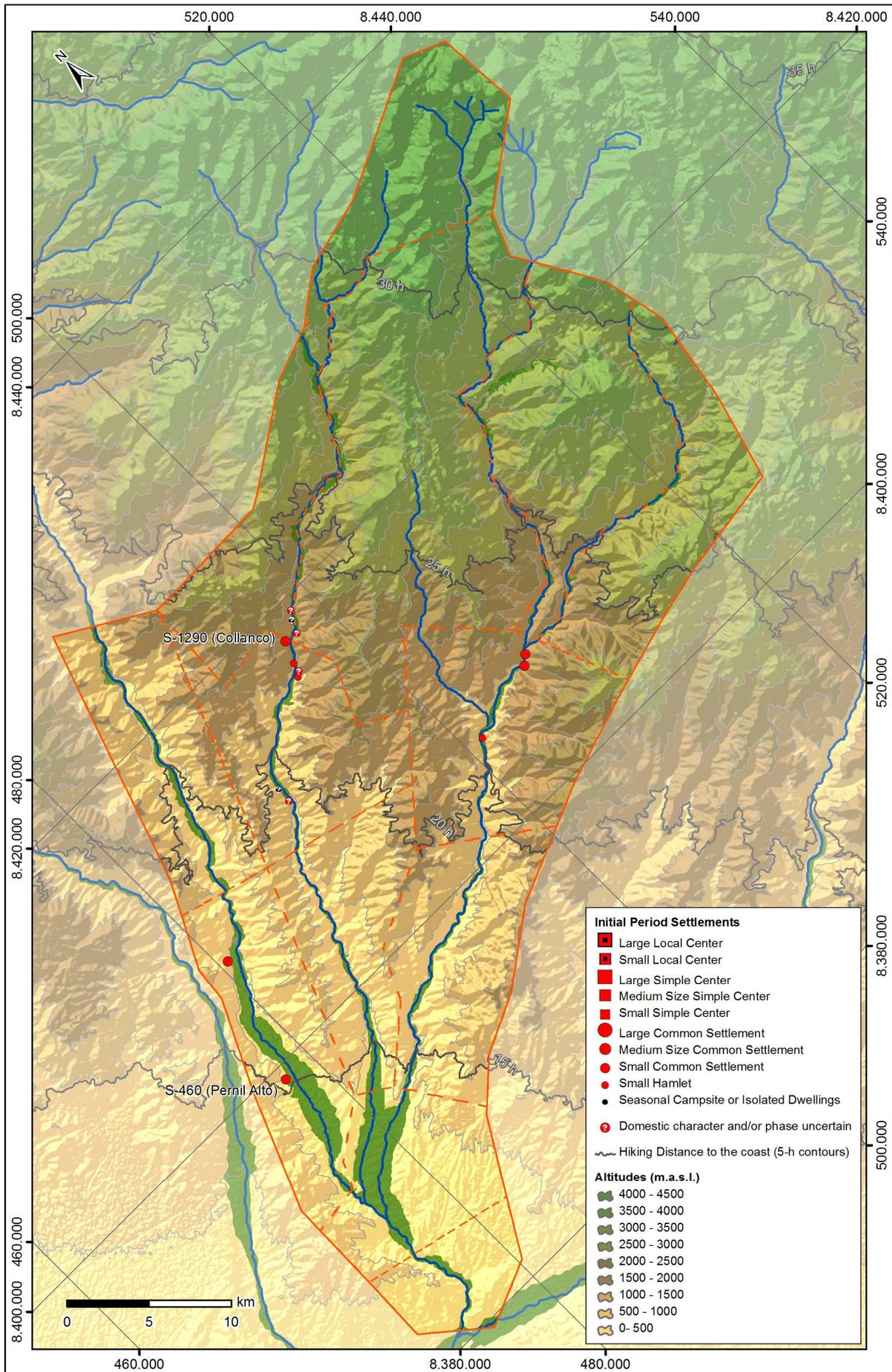
Figure 52: Relative altitude above the valley floors and walking time distance to the coast for settlements at the IP-EP transition. Graphic: VS.

peared or have not been identified, it is obvious that population density was low and most resources were available in abundance. It therefore seems plausible to assume that population levels and perhaps also *per capita* consumption tended to rise constantly.

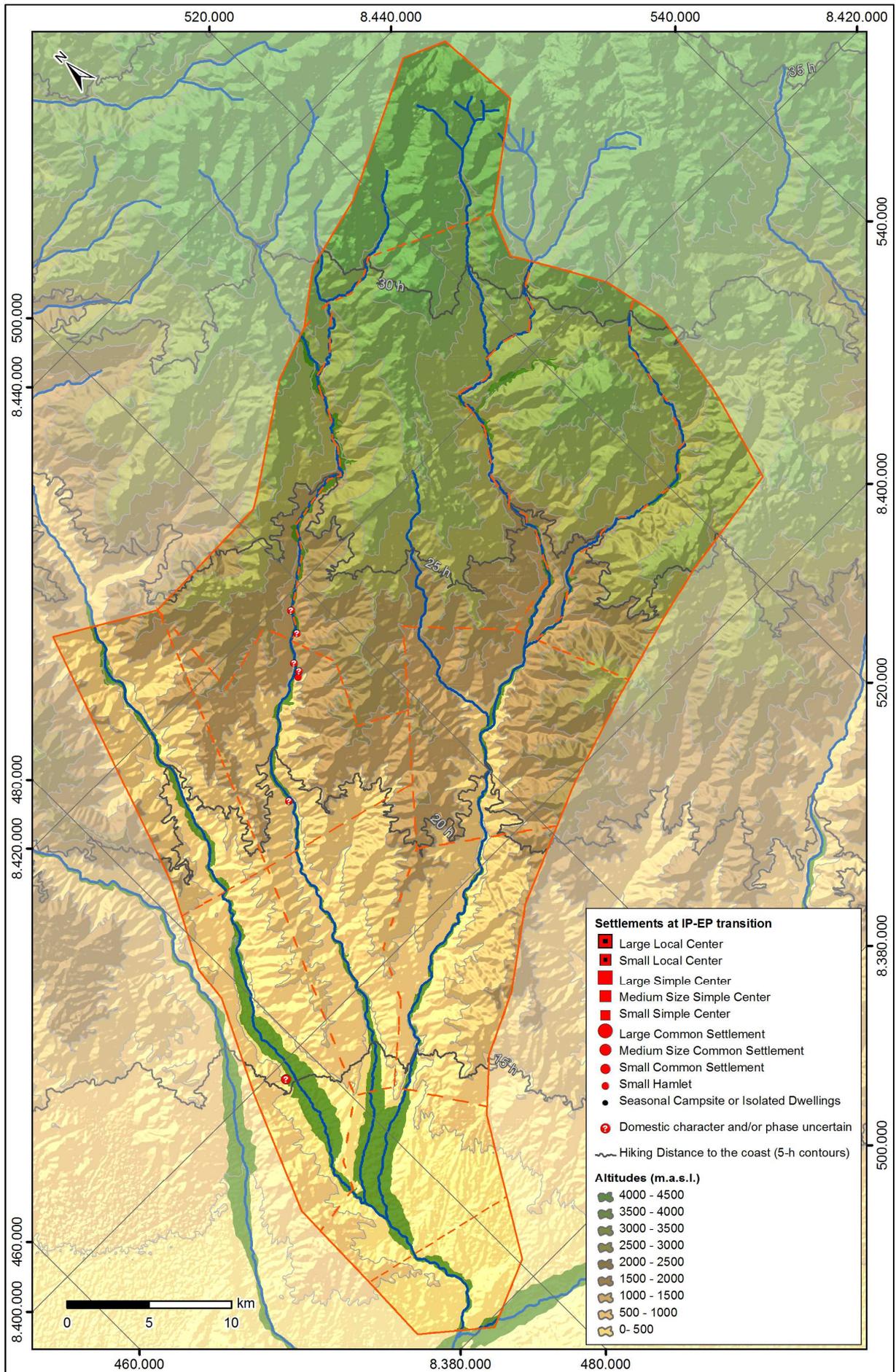
Interestingly, apart from S-460 (Pernil Alto), all villages which stayed occupied in the succeeding Early Paracas phase were located in the upper Palpa valley (Map 12). Possibly, settlements shifted during the IP from Viscas to Palpa. In this case, those in the Viscas valley would represent an earlier sub-phase. This hypothesis remains to be confirmed by future excavations and numeric dating. Both, the relative altitude and the average walking time to the coast stayed roughly the same (Figure 52). In general, there seems to have been a large degree of smooth continuity between the IP and the Early Paracas phase.

Initial Period Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	Phase length
Likely date: 1500 BCE		840 BCE	Likely length: 660 years
Earliest possible date: 1500 BCE		900 BCE	Shortest possible length: 560 years
Latest possible date: 1460 BCE		800 BCE	Longest possible length: 700 years
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
Total:	14 (8)	6.90 ha (5.36 ha)	0.49 ha (0.67 ha)
<i>b-type settlements (minimum extent):</i>	1 (1)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
At phase start (types a + bS):	1 (1)	0.13 ha (0.13 ha)	0.13 ha (0.13 ha)
At phase end (types bE + c):	7 (3)	3.11 ha (0.58 ha)	0.44 ha (0.19 ha)
Established after phase start and abandoned before phase end (type d):	7 (5)	3.45 ha (3.12 ha)	0.49 ha (0.62 ha)
Growth and dislocation			
Area net growth: (unknown)			
Dislocated area: (unknown)			
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
Area growth per year:	(unknown)	(unknown)	(unknown)
Population Index:	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Status classes			
Number of settlements		Settlement area	
Non-permanent settlements:	1 (0) 7.1 % (0.0 %)	0.01 ha (0.00 ha)	0.2 % (0 %)
Common settlements:	13 (8) 92.9 % (100 %)	6.88 ha (5.36 ha)	99.8 % (100 %)
Simple centers:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Local centers:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Administrative posts:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Administrative centers:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Population size classes			
Number of settlements		Settlement area	
Isolated dwellings:	2 (0) 14.3 % (0.0 %)	0.17 ha (0.00 ha)	2.4 % 0.0 %
Small hamlets:	7 (3) 50.0 % (37.5 %)	2.42 ha (1.05 ha)	35.1 % 19.6 %
Small settlements:	5 (5) 35.7 % (62.5 %)	4.31 ha (4.31 ha)	62.5 % 80.4 %
Major settlements:	0 (0) 0.0 % (0.0 %)	0.00 ha (0.00 ha)	0.0 % 0.0 %
Population centers:	0 (0) 0.0 % (0.0 %)	0.00 ha (0.00 ha)	0.0 % 0.0 %

Figure 53: Basic data of Initial Period settlements. Graphic: VS.



Map 11: All settlements of the Initial Period. Map: VS.



Map 12: Settlements probably occupied simultaneously at the transition from the Initial Period to the Early Paracas phase. Map: VS.

6.4 The Paracas Period

The spread of iconographic features originating from the North Coast and the Northern Highlands all over the Central Andes during the first millennium BCE marks the period of the Early Horizon. On the South Coast, the dominant archaeological culture of that time is known as Paracas. The Paracas culture group clearly developed out of the preceding local Initial Period societies as evidenced by continuities in iconography and settlement. A number of designs originating from the IP were still in use during Paracas times and many settlements show continuous occupations. Apparently, cultural features from the north were adopted by the local population and merged with its own traditions. Only recently, the works of the Palpa Project showed that sherds of the typical Paracas ceramic style can also be found at many highland sites, which argues against the traditional perception of a distribution area limited to the coastal strip and the foothills. However, delimiting the settlement area of a culture group exclusively on the basis of the distribution of a certain style is surely insufficient and may lead to doubtful results. Towards the end of the Early Horizon, significant cultural changes are observable in the archaeological record, including a massive population growth, new burial customs, and foreign influences on ceramic and textile designs. In the Río Grande drainage, the Nasca culture began to develop during the last centuries BCE by merging old Paracas traditions with new cultural elements.

6.4.1 The Early Paracas Phase (EP)

For the temporal delimitation of the Early Paracas phase, only four ^{14}C samples originating from Pernil Alto and Mollake Chico have been considered in the latest chronological model (Unkel et al. 2012:2301). These may not be representative for the whole study area, let alone the South Coast in general. Accordingly, the future incorporation of additional samples may lead to a shift of the phase's temporal delimitation. The earliest numeric date from the NGD for the beginning of the Paracas Period is 840 BCE while around 500 BCE some stylistic innovations mark the beginning of the Middle Paracas phase. Early Paracas then lasted for about 340 years, which significantly increases the chance of settlement contemporaneity compared to the IP. Considering the fuzziness of the phase delimitation, it is still possible that this phase actually lasted about a century longer or shorter.

Twenty settlements with a total area of 9.9 ha were assigned to the Early Paracas phase. These were modest in size and with 0.49 ha on the average comparable to their IP counterparts. Three settlements comprising 3.3% of the overall EP settlement area were classified as isolated dwellings, nine as small hamlets (30.1%), and seven as small settlements (48.4%). Only S-1293 can be regarded as a major settlement, but this one alone made up 18.2% of the total area (Figure 59).

6.4.1.1. Settlement Layout and Construction Techniques

At the foothills, Early Paracas villages consisted almost exclusively of light rectangular wattle-and-daub huts or structures with clay walls on a low stone foundation, mostly erected on low, simple construction terraces that follow the natural terrain contours. Small-scale excavations at PAP-265 (Reindel et al. 2006, Reindel & Isla Cuadrado 2006/2009), only a few meters to the northwest of PAP-266 (Pernil Alto), unveiled the remains of such EP domestic terraces with interior subdivisions (S-461). The retaining walls, up to 1.3 m high, were constructed with cobbles on the basis of a single line of bigger, earth-mortared stones (Figure 54) and in some cases also with small mud blocks and irregular *adobes*. It is likely that on top of the stone layers, light wattle-and-daub walls were erected and that the rooms were roofed with reed, although no direct evidence for this hypothesis was found. Intrusive simple graves with some vessels in the Ocucaje 4 and 5 styles prove that the settlement dates to EP or



Figure 54: Remains of the retaining wall of a dwelling terrace dating to the Early Paracas phase excavated at PAP-265 (Pernil Alto), next to the IP settlement S-460. The terrace probably formed the base for a wattle-and-daub hut. Photo: Palpa Project.

even earlier, because it had already been abandoned when the tombs were dug out.

Further modest traces of EP domestic activity related to S-1091 were found in a test pit at PAP-306 at the left margin of the Viscas valley, just before it opens into the great floodplain (Reindel et al. 2002, Isla Cuadrado 2010:24-25). Although the excavations were more limited and no retaining walls were uncovered completely, the general construction pattern seems to be similar to that of S-461. A special case is S-558 (PAP-205) in the lower part of the upper Palpa valley. Here, very regular low rectangular terraces and enclosures can be observed which might not have had purely domestic functions. These were partly destroyed during the Middle Nasca phase by the construction of a trapezoid geoglyph (Figure 55). S-1411 (PAP-1067) and S-1282 (PAP-1066) are only known from sherd scatters on agricultural terraces and inside a settlement dating to the Initial Nasca phase, respectively. The younger structures probably covered or destroyed the older ones. As a consequence, nothing can be said about the design of these EP villages without excavating.



Figure 55: The site PAP-205: Relatively large and regular low terraces and enclosures from Early (S-558) and Middle Paracas (S-557) times are cut by a later Middle Nasca trapezoid geoglyph. Photo: VS.

In the upper valleys, no excavations have so far taken place at an EP site. From surface prospection it is known that some domestic terraces in the Collanco section must have been constructed during the Early Paracas phase. On top of these, cobble dwellings were built which were of circular, oval, or irregularly round shapes with a diameter of two to six meters rather than angular structures as they are known from the foothills. These constructions often incorporate the retaining walls of the terrace behind them and sometimes it is hard to distinguish between terrace and dwelling wall. The habit of using stones to construct not only terraces but also the house walls themselves and the preference for roundish shapes over angular ones seems to be limited to the upper valley dwellers.

A typical settlement of this kind is S-1293 (PAP-1079), which contains about 40-50 of these round, oval, or irregular structures, although some dwelling terraces and the associated structures are almost completely eroded. On the opposite valley margin stretches the large terrace complex of Collanco which had been registered as several independent sites (PAP-1075, PAP-1077, and PAP-1078). Most of the terraces seem to have served agricultural purposes, but especially at the borders there are substantial domestic sectors, too. Only PAP-1078 surely contains an EP occupation (S-1292) while PAP-1075 (S-1416) could only be classified as 'Paracas' in general but was not assigned to a sub-phase. It comprises the largest number of apparent domestic structures (Figure 56). Its sector C has been identified on air photos but still lacks detailed registration in the field. PAP-1077 contains a Late Paracas occupation. Since the Collanco valley sector and the adjacent sections were favored settlement areas during the Paracas Period, Reindel and Isla plan a full-coverage detailed measurement combined with excavations in 2013/2014. The results will help clarifying the nature and extent of the occupations during different phases.



Figure 56: Round domestic structure at PAP-1075. This type of house form is common in all Paracas phases but only in the upper valley sections and the *cabezadas*. Photo: Palpa Project.

Whether or not permanent villages existed during the Early Paracas phase in the *cabezadas* is still not clear. Five smaller settlements show surface sherds that are identifiable as Paracas in general but these sherds are non-diagnostic or too small to distinguish a specific sub-style. A single EP/MP sherd which could be anything from Ocucaje 3 to Ocucaje 6 was found at PAP-763 (Cruz Pata) in the *cabezadas*, close to modern-day Laramate. The site preserves a number of terraces up to two meters high at the flank of a ridge and the foundations of some enclosure walls on the ridge itself. The place was also occupied in the Nasca and Wari Periods and it seems likely that at least the well preserved terraces date to a late phase. Nevertheless, it is possible that an early occupation is buried under the much younger structures. In this case, it would likely be related to the Middle Paracas

settlement S-95 whose principal sector lay only a few dozen meters east (c.f. Chapter 6.4.2). If the EP settlement S-1737 existed at all, it was probably only a small and simple one.

6.4.1.2. Settlement Location and Subsistence

Early Paracas villages were located from 14-23 hours of walking time from the coastline (Figure 57). Even when keeping in mind conservation issues, it becomes clear that the uppermost part of the Palpa valley (around Collanco) was the major focus of settlement activity while the lower valley sections were apparently only sparsely populated (Map 13). According to the paleo-environmental model (Chapter 2.2.3), the climate had turned comparatively less arid after 850 BCE. This would have offered ideal conditions for rain-dependent terrace farming in the upper valleys, including Collanco, and would explain the large scale agricultural terrace systems in the area which cannot be cultivated at present due to insufficient precipitation. The Collanco area was too far away from the coast to incorporate seafood as a principal component of the daily diet¹⁰⁶ but both the broad forested floodplains and the *puna* could be reached in a day's walk (≈ 8 h). At the foothills, *huarango* pods and other wild plants could be foraged. Additionally, a variety of goods, namely *yunga* crops, could be exchanged with the inhabitants of the foothill settlements. While the absence of large pens in the *puna* suggests that herding was not practiced by the people occupying the study area in the Early Paracas phase, the highlands may have been important hunting grounds.

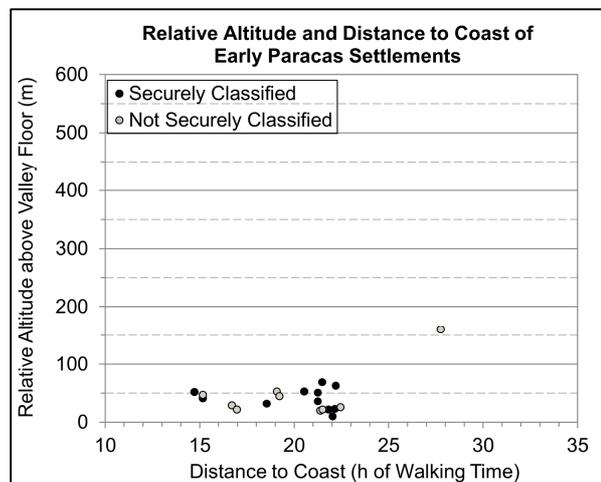


Figure 57: Relative altitude above the valley floors and walking time distance to the coast for Early Paracas settlements. Graphic: VS.

6.4.1.3. Hierarchy and Defensive Measures

EP settlements were all located at relative altitudes of less than 100 m above valley floor level (except S-1737 which perhaps does not date to this phase) and most even below 50 m (Figure 57). All were easily accessible and no remains of protective walls or other defensive measures can be observed.

¹⁰⁶ This does not mean that no seafood was consumed in the highlands. At a number of sites, shells of edible mussels scattered on the surface prove access to coastal resources but the quantity of these remains is much too low to assume that seafood might have made up a substantial part of the diet.

Like in the preceding Initial Period, there is no village which shows clear indicators for a status above that of a common settlement. Only S-558 in the middle Río Grande valley is special in that it consists of very regular terraces and enclosures. But the site had also been occupied in Middle Paracas, so it is hard to tell how much of the observable architecture was actually constructed during EP. Furthermore, there are no close-by villages that could have been subordinate to S-558, although this could also be a conservation issue. Although to date, there are no substantial indications for a formal hierarchy above the level of the village community, the dense population cluster around Collanco makes this area the most likely place where a center, if any ever existed in Early Paracas times, would have been established. S-1416 would be a plausible candidate if the projected excavations revealed evidence of an EP occupation.

6.4.1.4. Major Inter-Phase Developments

During the Early Paracas phase the total settlement area grew by 91% from 3.11 ha at the beginning of the phase to 5.96 ha at its end (Figure 59). Considering the likely phase length of 340 years, the average growth rate would nevertheless have been only 0.19% per year. This rate can be explained by local population growth. There seems to be a certain increase in the average settlement area from 0.39 to 0.54 ha but due to the low number of settlements taken into account (eight at the phase start and 11 at the phase end) this observation is tentative.

Regarding the location and distribution of settlements, the cluster in the upper Palpa valley without doubt remained the focal point of settlement activity during the whole phase while the emergence of some small pioneering villages in the middle and upper Viscas valley may have been a new development. Some of the older villages were abandoned but replaced by others which were established close-by (compare Map 14 and Map 16). In total, 50.5% (1.57 ha) of the settlement area in use at the phase start had been dislocated by the phase end. In terms of relative altitude and relative distance (compare Figure 51 and Figure 58), there was no significant change. Throughout the phase, all settlements (except the doubtful occupation of S-1737) are located below 100 m above valley floor level and at a walking distance of 15-23 hours from the coast. All in all, the Early Paracas phase seems to have been a time of little change in settlement behavior.

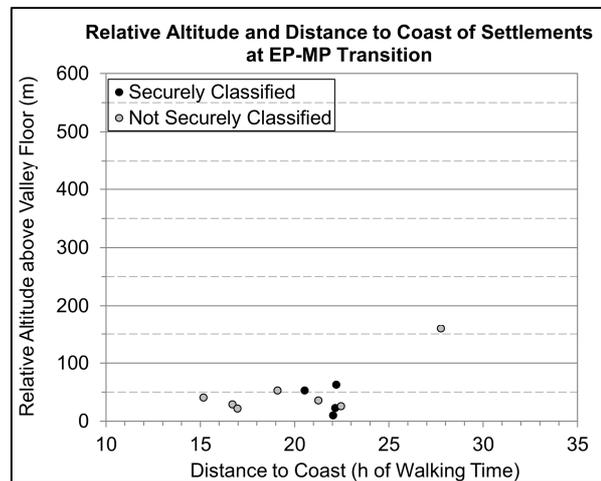
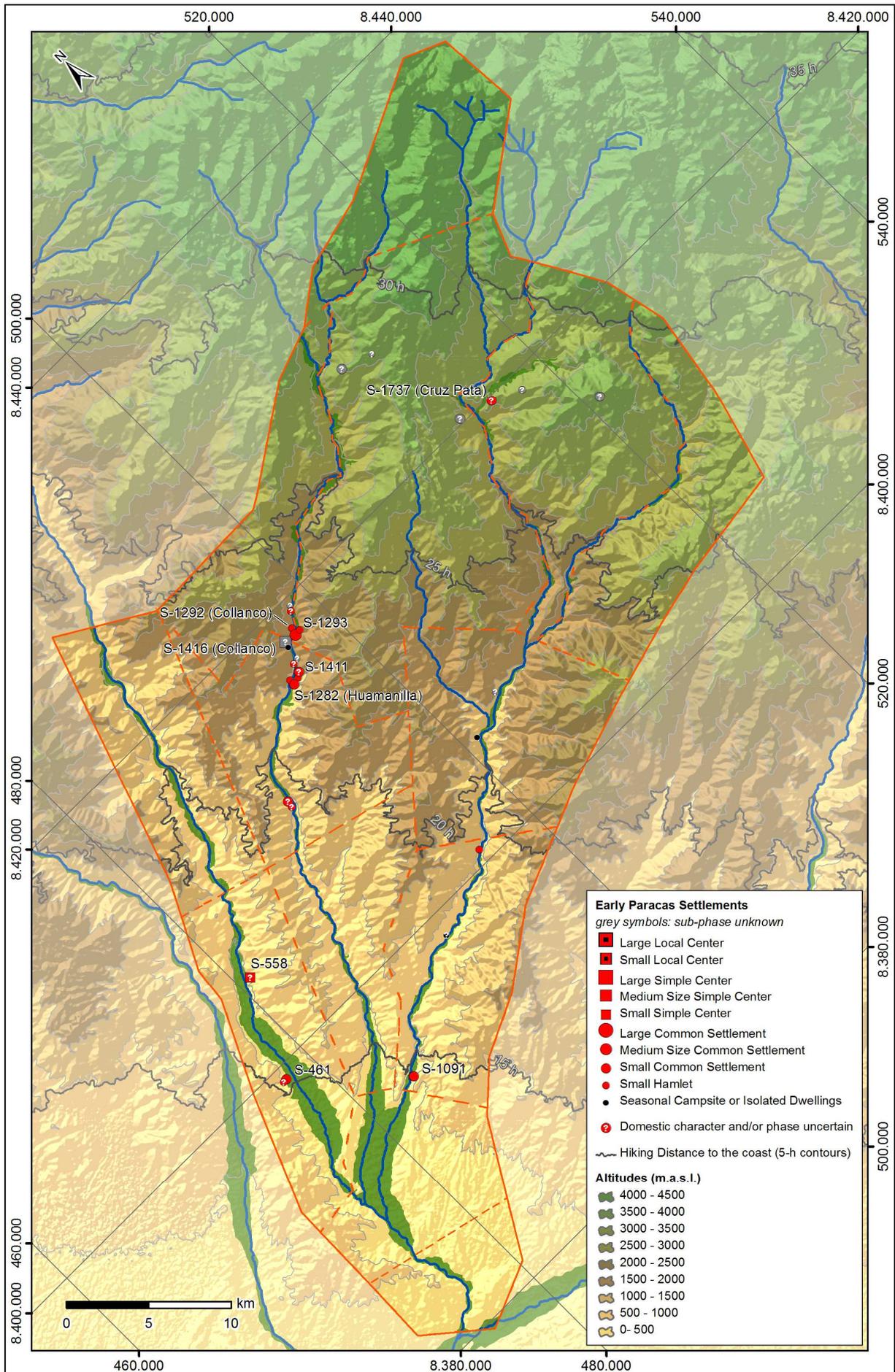


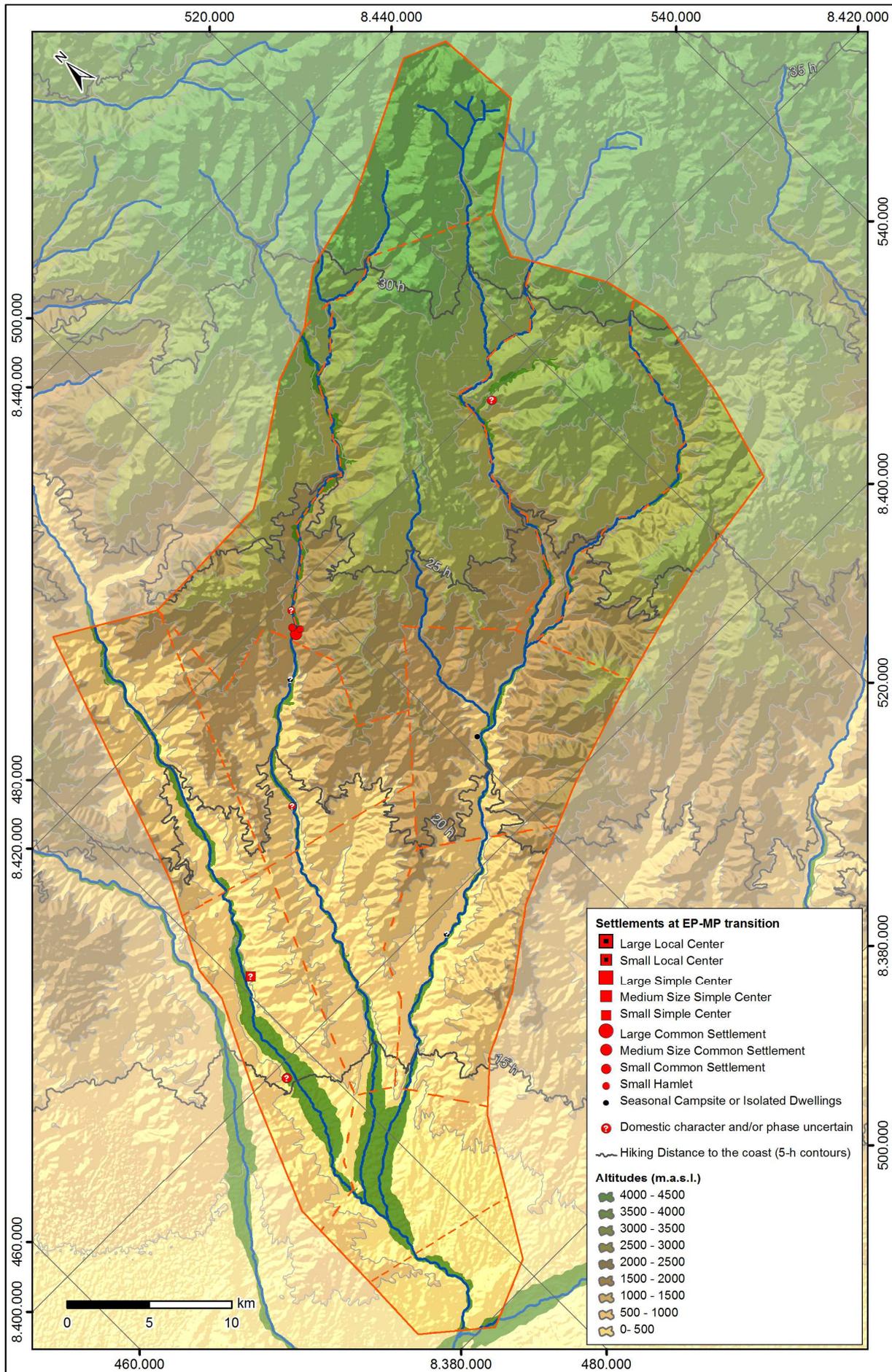
Figure 58: Relative altitude above the valley floors and walking time distance to the coast for settlements at the EP-MP transition. Graphic: VS.

Early Paracas Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
Likely date: 840 BCE		500 BCE	
Earliest possible date: 900 BCE		560 BCE	
Latest possible date: 800 BCE		440 BCE	
			Phase length
			Likely length: 340 years
			Shortest possible length: 240 years
			Longest possible length: 460 years
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
Total:	20 (11)	9.85 ha (5.67 ha)	0.49 ha (0.52 ha)
<i>b-type settlements (minimum extent):</i>	3 (1)	1.54 ha (1.18 ha)	1.18 ha (1.18 ha)
<i>At phase start (types a + bS):</i>	8 (2)	3.11 ha (1.56 ha)	0.39 ha (0.78 ha)
<i>At phase end (types bE + c):</i>	11 (6)	5.96 ha (3.60 ha)	0.54 ha (0.60 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	4 (4)	2.27 ha (1.91 ha)	0.57 ha (0.48 ha)
Growth and dislocation			
<i>Area net growth:</i>	2.85 ha (2.04 ha)	91.4 % (130.7 %)	
<i>Dislocated area:</i>	1.57 ha (0.38 ha)	50.5 % (24.1 %)	
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
<i>Area growth per year:</i>	0.19 % (0.25 %)	0.27 % (0.35 %)	0.14 % (0.18 %)
<i>Population Index:</i>	0.03 (0.02)	0.04 (0.02)	0.02 (0.01)
Status classes			
Number of settlements		Settlement area	
<i>Non-permanent settlements:</i>	0 (0)	0.00 ha (0.00 ha)	0.0 % (0 %)
<i>Common settlements:</i>	19 (11)	9.29 ha (5.67 ha)	94.3 % (100 %)
<i>Simple centers:</i>	1 (0)	0.56 ha (0.00 ha)	5.7 % (0 %)
<i>Local centers:</i>	0 (0)	0.00 ha (0.00 ha)	0.0 % (0 %)
<i>Administrative posts:</i>	0 (0)	0.00 ha (0.00 ha)	0.0 % (0 %)
<i>Administrative centers:</i>	0 (0)	0.00 ha (0.00 ha)	0.0 % (0 %)
Population size classes			
Number of settlements		Settlement area	
<i>Isolated dwellings:</i>	3 (2)	0.33 ha (0.17 ha)	3.3 % 3.0 %
<i>Small hamlets:</i>	9 (5)	2.96 ha (1.75 ha)	30.1 % 30.9 %
<i>Small settlements:</i>	7 (3)	4.77 ha (1.95 ha)	48.4 % 34.4 %
<i>Major settlements:</i>	1 (1)	1.79 ha (1.79 ha)	18.2 % 31.6 %
<i>Population centers:</i>	0 (0)	0.00 ha (0.00 ha)	0.0 % 0.0 %

Figure 59: Basic data of Early Paracas settlements. Graphic: VS.



Map 13: All settlements of the Early Paracas phase. Map: VS.



Map 14: Settlements probably occupied simultaneously at the transition from the Early to the Middle Paracas phase. Map: VS.

6.4.2 The Middle Paracas Phase (MP)

The Middle Paracas phase was a time of great change. Settlement activity boomed, population levels rose quickly, and large settlements were established in the formerly almost uninhabited *cabezadas* (Map 15). This significant development took place in the comparatively short 120-year-period from 500-380 BCE, if considering the likely start and end dates for the phase. These dates, however, are based on 11 ¹⁴C samples all of which originate from the site PAP-150 (Jauranga) (Unkel et al. 2012:2301). Whether they are actually representative for the phase in general will have to be confirmed in the future when additional samples from other well-documented contexts might be available.

Settlements became not only more numerous but also larger. The average size of the 64 villages more than doubled from 0.5 to 1.0 ha and the total settlement area amounted to 65.1 ha. Major settlements made up for 50.8% of the total area, and the only population center (S-230 at PAP-894 (Malma)) comprised another 10.2%. The remaining area belongs largely to small settlements (30.2%) while the share of small hamlets (6.5%) and isolated dwellings (2.4%) is not significant (Figure 64). The establishment of larger settlements is a new development in the study area.

6.4.2.1. Settlement Layout and Construction Techniques

The best evidence of a Middle Paracas settlement at the foothills derives from excavations at Jauranga (PAP-150, S-664) where several superimposed layers of angular room structures from successive construction phases were found (Isla Cuadrado et al. 2003, Isla Cuadrado & Reindel 2007, Reindel & Isla Cuadrado 2004) (Figure 63). The walls were built of compacted clay and *quincha* and some had a stone foundation. This is consistent with the finds for the Early Paracas settlement at Pernil Alto (S-461) and probably represents the typical construction pattern for EP and MP settlements at the foothills in general. In most other cases, either the MP features are buried under occupations from later phases or the only remains consist in a few eroded construction terraces.

At Jauranga, the earliest occupation associated with ceramics of the Ocucaje 5/6 styles seems to have been of small size. Only a few walls could be attributed to it. A notable remodeling and amplification related to Ocucaje 7 vessels must have taken place a bit later. The most intensive and probably also extensive use of the site dates to the Late Paracas phase and is associated with Ocucaje 8 and 9 vessels and sherds (S-663, see Chapter 6.4.3.1).

In the upper valleys, MP settlements were usually located at terraced valley slopes and mostly consisted of round stone houses incorporating the retention wall of the backward construction terrace. These walls are usually single-faced. For the first time, numerous villages were also established at the *cabezadas*, most of them as a new type of hilltop settlement. These were characterized by a more or less concentric layout with construction terraces surrounding a flat – or artificially leveled – hilltop. The houses were round and similar to those in the upper valleys, although on average they followed the ideal circular shape more strictly.

An especially interesting feature observable at a number of Middle and Late Paracas settlements is the occurrence of “flowers” which had first been discovered by Carolina Hohmann during her *cabezadas* surveys. These are groups of small, D-shaped structures arranged around a circular place like petals in a flower. Their function is still not clear and might not even have been the same at all sites and all times. Anyway, “flowers” are certainly a special feature and their presence might be an indicator for a status above that of a common settlement. Since they are more common in Late than in Middle Paracas settlements, they will be treated in more detail in the following Chapter 6.4.3.1.

At the *cabezadas*, test pits have been dug by the Palpa Project into two sites with MP occupations: PAP-894 (Malma, S-230) and PAP-873 (Suito Orqo, S-217). In the latter case, however, the settlement is overbuilt with younger Middle Nasca structures. Only traces of a simple single-face wall belonging to a small Middle or Late Paracas round house were discovered in one of the excavation units. The surface sherd assemblage nevertheless points to a substantial MP occupation but the superficially visible structures mostly belong to the MN settlement.

At Malma, the remains of about 200 round stone houses with a diameter of 3-5 m are still visible on the surface. The great majority of them date to the Middle and Late Paracas phases, although part of the site seems to have been reused in Middle Nasca and Ica times. One of the houses at Malma was excavated by the Palpa Project in 2009 (Figure 60) but the excavation revealed very little additional information (Reindel & Solís Quinteros et al. 2010). It probably once looked similar to the recent hut in



Figure 60: Excavated small Middle Paracas round stone house at Malma (PAP-894, S-230). The walls have collapsed long ago and the surface is constantly being disturbed by grazing goats, so the cultural layer is very thin. The structure probably once looked similar to the recent hut in Figure 49g. Photo: Palpa Project.

Figure 49g. Several houses were usually arranged around a central patio and were probably inhabited by members of the same family or kin group. Some of these patio groups were surrounded by broad, up to 1.2 m high murals which partly also served as retaining walls for construction terraces. At Malma, also one of the petals of an apparent flower structure was excavated but revealed nothing more than the single-walled stone base.

As S-230 existed into the beginning of Late Paracas, one might argue that at least part of the houses and flowers could actually date to this phase. The problem is that almost all larger MP highland settlements were also reused and overbuilt in later phases. The only exception is S-249 (PAP-914) but here, too, the superficially observable structures, including some flowers, follow the same pattern described above. Accordingly, there is good reason to assume that there

was little change in settlement layout between Middle and Late Paracas.

6.4.2.2. Settlement Location and Subsistence

The numerous newly established large villages at the *cabezadas* were located far away from the coast but on the best soils of the highland farming belt and close to excellent *suní* and *puna* grazing grounds. Figure 61 and Map 15 both illustrates the amplification of the settlement area towards the highlands at more than 25 hour walking distance from the coast.

Although the great floodplain and the middle valleys seem to have stayed only sparsely settled, at least one first village was established in the formerly unoccupied middle Palpa valley (S-944 at PAP-526) at the end of the phase.¹⁰⁷ To date, S-664 at PAP-150 (Jauranga) is the only Middle Paracas settlement known to have been located in or around the great floodplain. Sea shells found in the domestic contexts prove that the inhabitants either regularly walked down to the coast to gather seafood themselves or exchanged goods with communities living close to the ocean (Isla Cuadrado et al. 2003:268). S-664's location on the valley floor itself (and not at the margin) suggests that there may have existed more contemporaneous villages now buried under sediments. Arguably, there still was no need to erect buildings outside the potentially cultivable area to maximize farmland and villages may have been established regularly in between the fields. Hesse (2008) assumes that the most elevated pre-Hispanic canal along the southeastern margin of the great floodplain must have been constructed around 770-410 BCE (2720-2360 cal BP) which would point to a significant extension of the irrigated area, perhaps already in the Early Paracas phase. This would not have made sense without a substantial number of consumers and an adequate labor force recruitable from nearby villages. Nevertheless, the greater part of the flood plain will probably still have been forested.

The settlement concentration in the Collanco area became even denser than in the previous phase and continued being a hotspot of domestic activity, but a new cluster also emerged in the upper Viscas

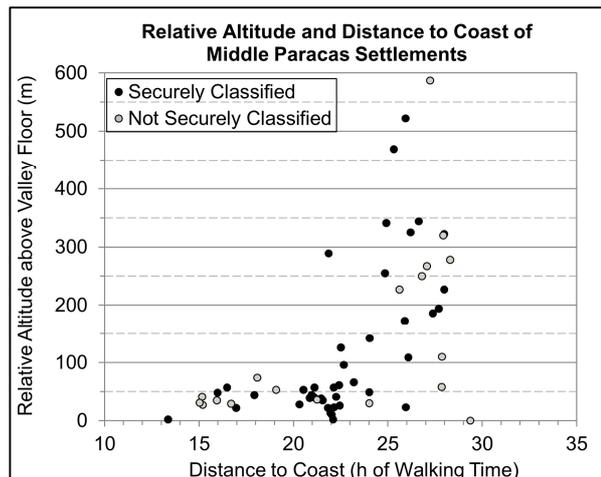


Figure 61: Relative altitude above the valley floors and walking time distance to the coast for Middle Paracas settlements. Graphic: VS.

¹⁰⁷ The site shows sherds of the styles Ocucaje 7-9 on its surface.

valley. After a prolonged time of climatic variability, favorable climatic conditions probably returned by 450 BCE. This would have allowed rain-fed agriculture to thrive again in these areas although there was comparatively little cultivable terrain as the valleys are narrow and the slopes at the margins are relatively steep. The two mentioned areas clearly focus on the river valleys and illustrate a certain tendency to establish villages close to each other.

The new foundations in the *cabezadas*, in turn, often lay far away from the major streams and maintained a distance of at least 1.5 km (line of sight) between them, even if not considering the mountainous terrain which constituted an additional obstacle. The ratio of population to cultivated area was apparently much more favorable. Although difficult to date, it is probable that the first construction phase of a good part of the many ancient agricultural terraces still visible today may date to Middle Paracas. Tubers and pseudo-cereals such as quinoa are the most productive staple crops to grow at this altitude and would have complemented maize and beans, among others, which thrive best at the *yunga* valley floors.

Some settlements also incorporated a few enclosures that might have served as pens for llamas and alpacas, but those with numerous and especially large structures of this type, for example S-142 at PAP-800 (Cabrachanca) and S-214 at PAP-870, are all located at sites which had also been occupied in later phases. For this reason, it is not clear if the pens had already been erected in the Middle Paracas phase. Nevertheless, camelid herding in the study area likely started in this phase, although at a probably modest scale. Camelid bones excavated at S-664 (PAP-150, Jauranga) suggest a brisk exchange network from the *cabezadas* to the foothills, and, considering the shell finds mentioned above, further down to the coast (Isla Cuadrado et al. 2003:268). Nevertheless, the possibility cannot be discarded that additionally, camelids were brought in from regions outside the study area.

6.4.2.3. Hierarchy and Defensive Measures

Most *cabezadas* settlements were located on hilltops several hundred meters above the valley floor (Figure 61) and some had additional defensive walls to further restrict the access. This observation indicates that during the Middle Paracas phase violent conflicts were probably increasing, at least in the highlands. At the foothills, such a development is not clearly traceable.

Although three out of four MP settlements were common covering 63.5% of the total settlement area, the share of simple centers increased notably to 35.6%, compared to the 5.7% of the preceding phase (Figure 64). Nevertheless, this fact does not tell much about a formal hierarchy or even political units. The simple centers differed from common settlements only in that they showed additional special features like flower structures, defensive walls or exceptionally well made masonry. Not a single settlement seems to have had a status above that of a simple center.

Most of these simple centers were located at the *cabezadas* at both sides of the Laramate river, although high above the valley floor, and they were not surrounded by common settlements. Consequently, they cannot have fulfilled a central place function. S-1305 at PAP-1091 in the Collanco zone did have simple settlements close by but it does not show any remains of features hinting to administrative functions beyond the village level. It merely stands out for its elaborate terrace walls. Forthcoming excavations in the area might reveal further evidence for a center status.

By far the largest MP settlement was S-230 at PAP-894 (Malma). The presence of flower structures argues for a special status, but not necessarily to a formal dominant position towards any smaller village. The site PAP-205 in the middle Río Grande valley has already been mentioned in Chapter 6.4.1. The character of its MP occupation (S-557) remains unclear, but the size and regular layout of the terraces and enclosures argue for a status slightly above that of a common settlement or to additional non-domestic functions. Again, no simpler contemporaneous settlements have been registered nearby.

All in all, there seems to have been a certain differentiation between small and large settlements but this refers more to size than to status, and there is a distinction between *cabezadas* and upper valleys. In the latter areas, settlement density was higher, the average size smaller, and the architecture slightly simpler. At the *cabezadas*, especially in the eastern half, settlements were more dispersed but larger and more architecturally elaborate. The differences between both areas may be explained with different economic strategies, social structure, and topographic conditions.

6.4.2.4. Major Inter-Phase Developments

During the Middle Paracas phase, the total settlement area grew by 586% from about 6 ha to 39 ha in only 120 years (likely phase length, Figure 64). The resulting average yearly growth rate of 1.62% is by far the highest in the study area before the beginning of the Late Intermediate Period. Since there is no evidence of a substantially lesser average number of inhabitants per village compared to the preceding phases, the increase in settled area must reflect actual population growth on a scale not explicable by local reproduction alone. There must have been a major immigration wave into the study area during the MP phase, especially into the *cabezadas*. The new settlers were apparently specialized in highland farming and maybe also in camelid herding. Their original homeland therefore probably lay in a region with comparable environmental conditions. The general similarities in construction techniques to the upper valley dwellers and the use of the same decorated ceramics (though in much lower quantities) makes it likely that there were only minor, if any, cultural differences between both groups and that close contacts already existed before the immigration.

When comparing maps 14 and 16, two major developments regarding the distribution of settlements become apparent: first, the increasing importance of the Viscas valley, and, second, the massive settlement of the *cabezadas*. As a consequence, the walking distance range of the area settled at the end of the phase (13-29 h) increased significantly, compared to the phase start (15-23 h). However, when considering only reliably dated settlements it shrinks by almost 5 hours and comes close to the situation at phase start, again (Figure 62). This effect is basically caused by the low quantity of diagnostic surface finds in the highlands, which makes the dating of many settlements at which no excavations were carried out very difficult. The share of settlements at relative altitudes above 50 m clearly went up during Middle Paracas as a result of increasing conflicts. The percentage of dislocated settlement area of 64% is also higher than during Early Paracas (51%) and may as well reflect the necessity to move to defensible locations.

Altogether, the Middle Paracas phase seems to have been a time of significant change in settlement behavior. New immigrants occupied the *cabezadas*, boosting the growth of the overall population in the study area as a whole. At the same time, the first signs of defensive measures are observable in the archaeological record. Differences in settlement patterns between Early and Middle Paracas are clearly greater than between Initial Period and Early Paracas.

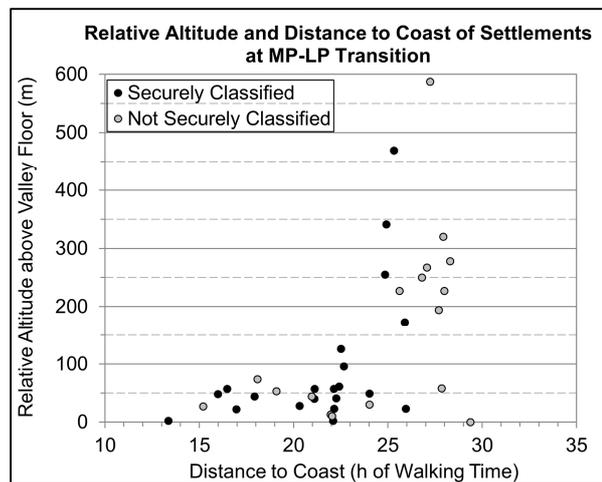


Figure 62: Relative altitude above the valley floors and walking time distance to the coast for settlements at the MP-LP transition. Graphic: VS.

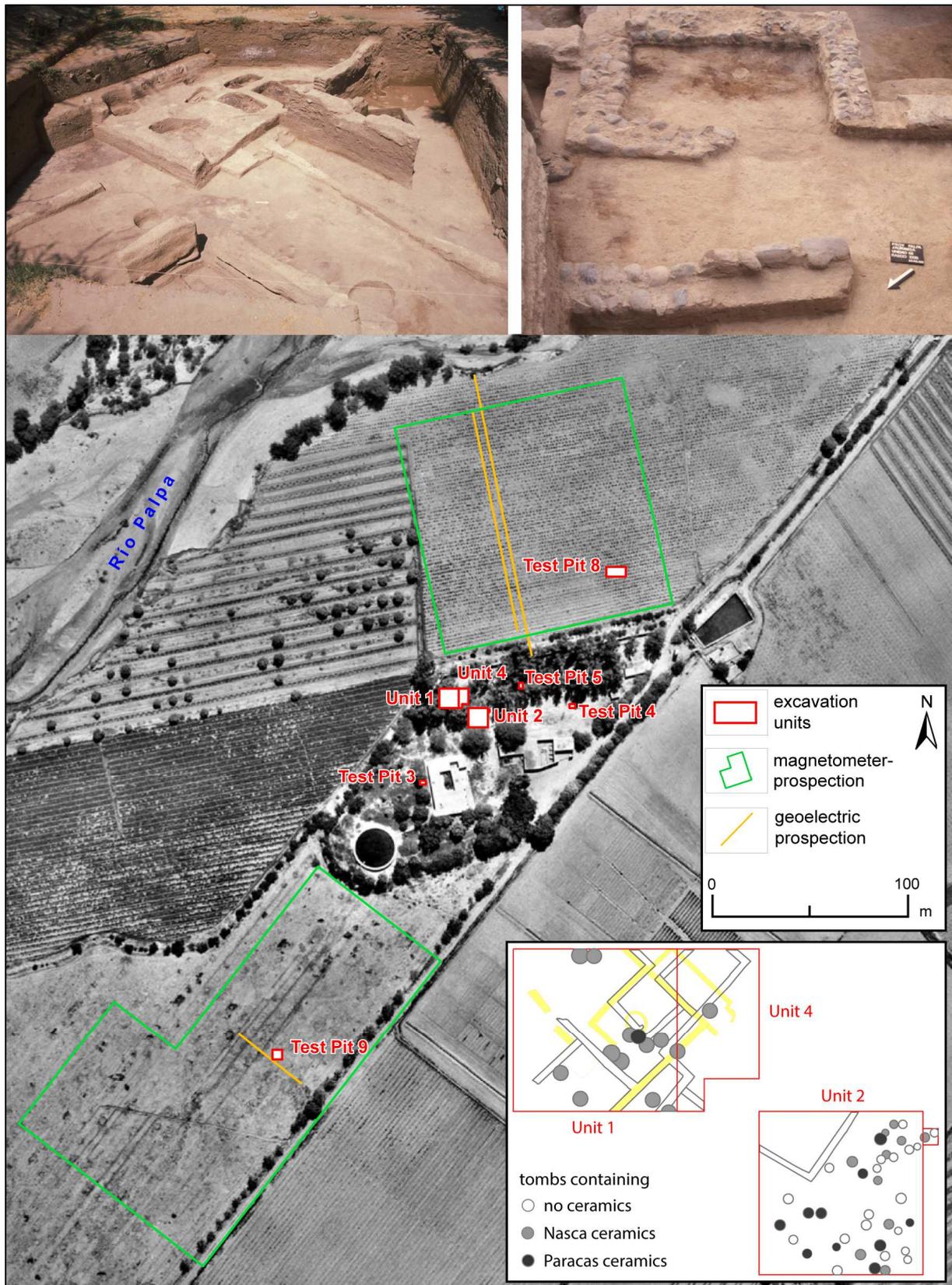
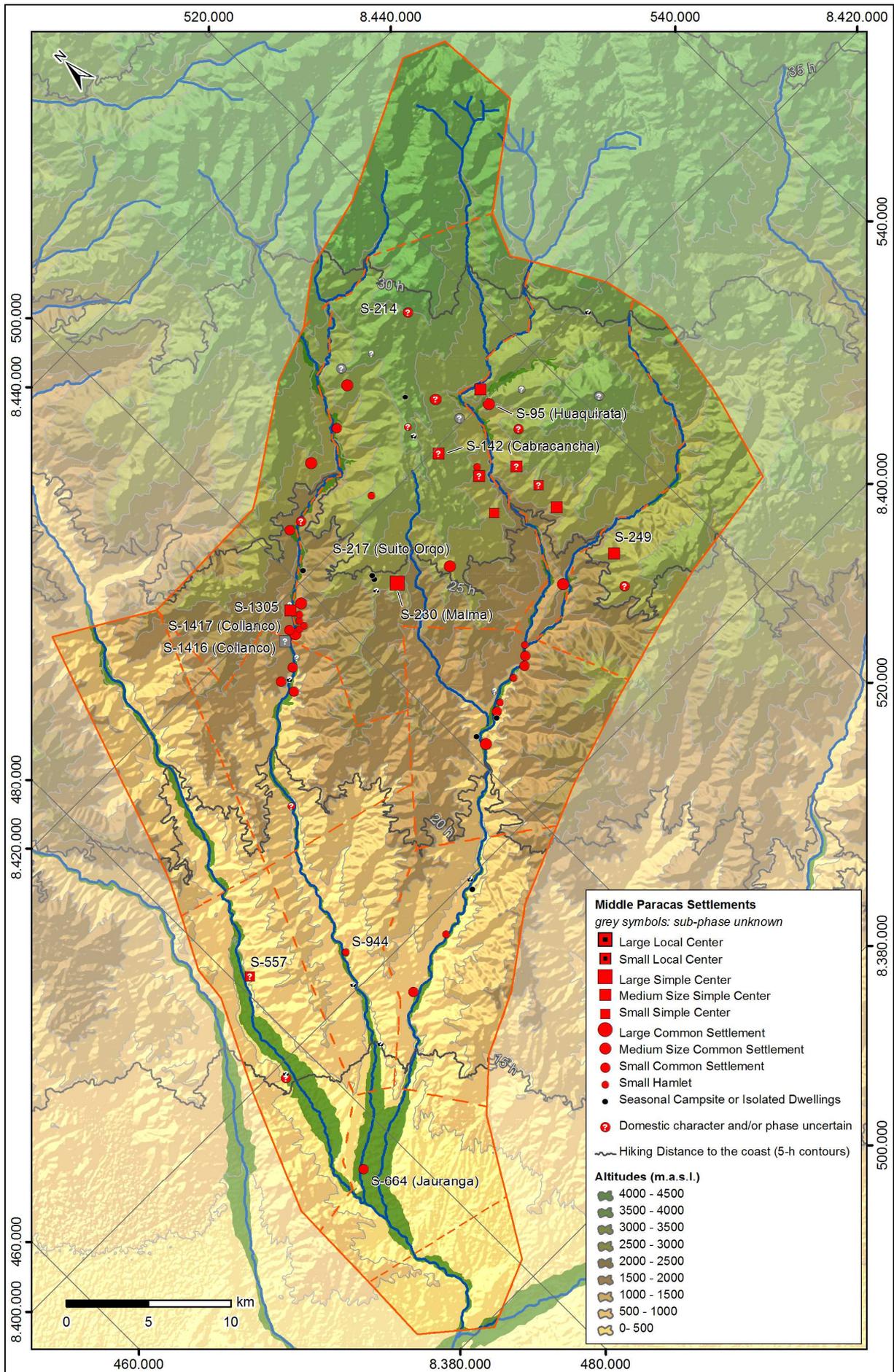


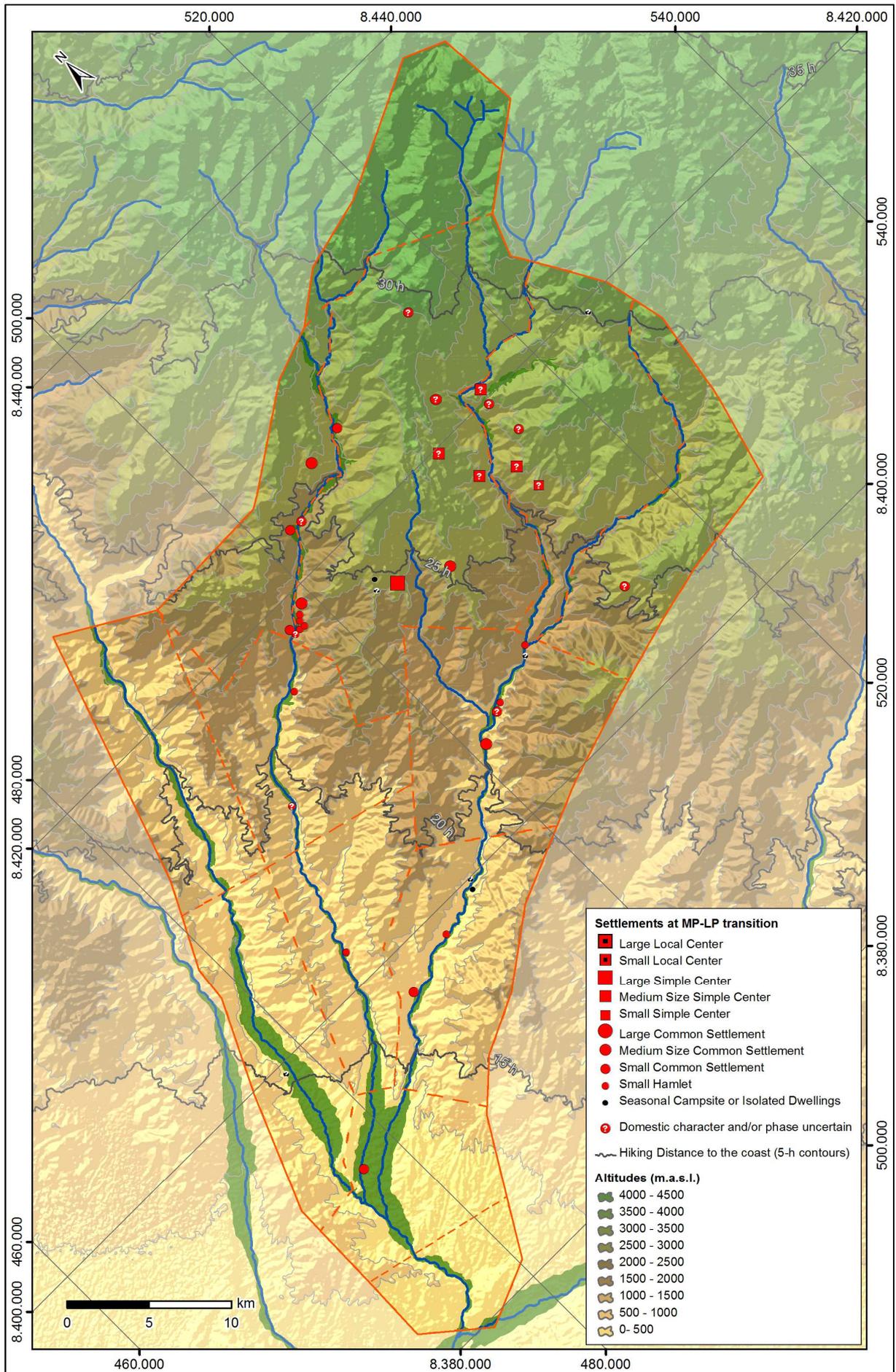
Figure 63: Overview plan of PAP-150 (Jauranga) indicating excavation units and areas where magnetometer- and geoelectric prospection was carried out. Upper left: remains of compacted mud walls of S-664. The pits in the upper left corner contain tombs as the settlement had been reused as a burial site from Late Paracas times onwards. Upper right: stone foundations probably once supporting light quincha walls excavated in unit 2. Photos and plan: Palpa Project.

Middle Paracas Settlements				
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation				
Phase start		Phase end		
Likely date: 500 BCE		380 BCE		
Earliest possible date: 560 BCE		400 BCE		
Latest possible date: 440 BCE		360 BCE		
			Phase length	
			Likely length: 120 years	
			Shortest possible length: 40 years	
			Longest possible length: 200 years	
Settlement number and area				
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>	
Total:	64 (43)	65.05 ha (51.15 ha)	1.02 ha (1.19 ha)	
<i>b-type settlements (minimum extent):</i>	6 (3)	1.50 ha (1.25 ha)	0.42 ha (0.42 ha)	
<i>At phase start (types a + bS):</i>	11 (4)	5.96 ha (3.25 ha)	0.54 ha (0.81 ha)	
<i>At phase end (types bE + c):</i>	40 (26)	40.89 ha (27.53 ha)	1.02 ha (1.06 ha)	
<i>Established after phase start and abandoned before phase end (type d):</i>	19 (16)	17.58 ha (16.48 ha)	0.93 ha (1.03 ha)	
Growth and dislocation				
Area net growth:	34.93 ha (24.28 ha)	585.9 % (748.0 %)		
Dislocated area:	3.79 ha (1.32 ha)	63.6 % (40.8 %)		
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>	
Area growth per year:	1.62 % (1.80 %)	4.93 % (5.49 %)	0.97 % (1.07 %)	
Population Index:	0.54 (0.43)	1.63 (1.28)	0.33 (0.26)	
Status classes				
	Number of settlements		Settlement area	
<i>Non-permanent settlements:</i>	5 (2)	7.8 % (4.7 %)	0.59 ha (0.36 ha)	0.9 % (0.7 %)
<i>Common settlements:</i>	48 (35)	75.0 % (81.4 %)	41.28 ha (34.35 ha)	63.5 % (67.2 %)
<i>Simple centers:</i>	11 (6)	17.2 % (14 %)	23.18 ha (16.43 ha)	35.6 % (32.1 %)
<i>Local centers:</i>	0 (0)	0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
<i>Administrative posts:</i>	0 (0)	0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
<i>Administrative centers:</i>	0 (0)	0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Population size classes				
	Number of settlements		Settlement area	
<i>Isolated dwellings:</i>	14 (7)	21.9 % (16.3 %)	1.53 ha (0.93 ha)	2.4 % 1.8 %
<i>Small hamlets:</i>	14 (11)	21.9 % (25.6 %)	4.24 ha (3.47 ha)	6.5 % 6.8 %
<i>Small settlements:</i>	19 (12)	29.7 % (27.9 %)	19.62 ha (14.18 ha)	30.2 % 27.7 %
<i>Major settlements:</i>	16 (12)	25.0 % (27.9 %)	33.04 ha (25.94 ha)	50.8 % 50.7 %
<i>Population centers:</i>	1 (1)	1.6 % (2.3 %)	6.62 ha (6.62 ha)	10.2 % 12.9 %

Figure 64: Basic data of Middle Paracas settlements. Graphic: VS.



Map 15: All settlements of the Middle Paracas phase. Map: VS.



Map 16: Settlements probably occupied simultaneously at the transition from the Middle to the Late Paracas phase. Map: VS.

6.4.3 The Late Paracas Phase (LP)

The Late Paracas phase likely lasted for roughly 120 years, from about 380-260 BCE. However, the margin of error for the relevant datings includes the possibility of a phase length as short as 30 or as long as 270 years, though these are unlikely extremes. Nevertheless, these uncertainties greatly affect any statistical calculation which directly involves the phase length. There seems to be a certain chronological offset between samples taken at the foothill site PAP-150 (Jauranga) and others originating from PAP-767 (Cutamalla) which is located at the *cabezadas* (Unkel et al. 2012:2301). In general, it is very possible that Late Paracas and Initial Nasca ceramics were in use simultaneously for a longer time, which would make an accurate assessment of either phase very difficult.

During Late Paracas, the principal developments which had started in the preceding phase reached a climax. Population levels continued to rise, although at a slower pace. Furthermore, the colonization advanced in all sections of the study area and fortifications became more common. The number of settlements grew to 165, which in sum covered an area of 189 ha. The average size did not change significantly as the respective value of 1.15 ha only slightly exceeds that for the previous phase. The share that the smallest villages had in the total area continued to drop: 1.8% for isolated dwellings and 6.5% for small hamlets. Small settlements only made up 23.7% while the bulk of settled area was composed of major settlements (43.4%) and population centers (24.6%). This clearly hints to a continuation of the general trend towards larger settlements (Figure 75).

Towards the end of Late Paracas, crucial cultural changes are observable in the archaeological record, which several scholars attribute to a strong influence or even migration movements from the valleys north of Pisco (Chincha and Cañete) where the so-called Topará culture developed (Peters 1997, Tinteroff Gil 2008, Wallace 1986, Silverman 1996).

6.4.3.1. Settlement Layout and Construction Techniques

In general, there was little change in settlement layout and construction techniques between Middle and Late Paracas. During Late Paracas, double-face stonewalls occurred more often. This technique was used for defensive walls, prominent buildings, and in the higher status settlements sometimes also for dwelling units. At the foothills, the employment of stone as the principal building material for most structures in the simple centers is a new development. In many small common settlements, in turn, the use of stone was largely limited to retaining walls and foundations. In these cases, most houses may still have been built of perishable material like *quincha* or compacted clay. Two basic patterns are typical for the layout of LP settlements located at the valley margins: firstly, unprotected dwelling structures erected on terraces at the middle and lower slopes, and secondly, fortified hilltops and ridges where the dwelling sectors were protected by natural terrain and additional walls and ditches. Combinations of both types occur, too. In these cases, a larger settlement may have one especially protected area, usually the highest point, but also some easily accessible sectors close to the valley floors.

Jauranga (PAP-150, S-663) offers the best insight into the layout of a Late Paracas settlement at the foothills (Isla Cuadrado et al. 2003, Isla Cuadrado & Reindel 2007, Reindel & Isla Cuadrado 2004) (Figure 63). It seems obvious from the density of architectural remains and domestic refuse that S-663 was larger than its precursor S-664, although the excavations did not unearth the whole village. The construction technique had not changed significantly and the rectangular buildings continued to be erected with walls of compacted clay and *quincha* while roofs were supported by wooden posts. Several construction phases were observed by the excavators and remains of burned *quincha* indicate that the structures were occasionally destroyed by a fire and had to be rebuilt. These events also generated opportunities for general remodeling.

S-663 is a special case in that it lies in flat terrain. Only two further settlements at the valley floor, both buried under thick layers of tilled top soil, had been found by chance. At PAP-734 (Yunama) the single-face foundation of one small circular structure and a thin cultural layer including some ash and domestic refuse can be associated with S-1047.¹⁰⁸ At PAP-737, some LP sherds were found in a cultural layer which belongs to S-1045. Both sites were cut in 2004 by pits which had been dug to

¹⁰⁸ Another round stone structure was found in the lowermost level of a test pit. It was associated with some marine shells but not with ceramic sherds. Markus Reindel (personal communication) suspects that this feature might even date to the Archaic Period, though further excavations and numeric dating will be necessary to test this hypothesis.

investigate the geomorphology of the valley floor (Hesse & Baade 2009). Though both settlements were probably small, their very existence is proof that the valley floors were settled, at least during the early phases. Besides these three cases, all other known settlements were located on slopes and hills.

An especially interesting settlement is S-16 at PAP-11 (Pinchango Viejo), located at the lower section of a mountain spur reaching from Cerro Pinchango down to the Palpa valley (Reindel et al. 1999, Reindel & Isla Cuadrado 2006, Sořna 2012). It covers more than 4 ha and has some interesting special features (Figure 73). First of all, it is protected against the adjacent hills by a massive wall, which still preserves up to two meters in height, and by a ditch directly in front of it (Figure 73, inlay). Some round, egg-sized, non-local riverbed pebbles can be found close-by. They served as slingshot ammunition, underlining the defensive character of the structure. Behind the largest wall, another four less massive wall-ditch systems stretch across the ridge, further restricting access to the principal dwelling sectors. Farther downhill, where the slope becomes more moderate, sit a number of slightly rounded but more or less rectangular stone structures. They were partly carved out of the loose and soft rock and consist of double-face walls built in drystone *pirka* technique. Most of them seem to have been dwellings, but at least two exceptionally large structures of about 9x12 m may have served other purposes, perhaps administrative ones.¹⁰⁹ A test pit dug into a simple terrace by the Palpa Project in 1997 confirmed that it was used during to the Late Paracas phase for domestic activities.

On the other side of the valley stretches extended settlement S-17, which includes several PAP sites. At PAP-458, the ancient structures in the fan of a *quebrada* were heavily damaged by modern reuse as pens, but the bases of finely set double-face stonewalls belonging to some rectangular buildings are still recognizable. In 1944, the whole *quebrada* was still covered by the remains of agglutinating rounded-rectangular structures comparable to those of Pinchango Viejo, as can be seen on the SAN aerial photo 524-241 (Figure 65). On both sides of PAP-458 stretch extended dwelling sectors, but these were reused and partly overbuilt in later phases. The looting in the area was especially intense during the last decades, devastating the archaeological remains. S-16 and S-17 represent the two basic types of settlement layouts mentioned in the first paragraph of this subchapter. Although both show similar architectural remains and very likely somehow formed a functional unit, S-16 was especially protected by the surrounding terrain and additional defensive walls while S-17 was easily accessible.

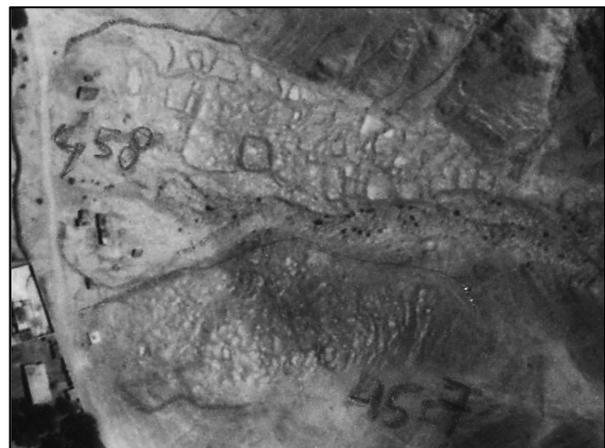


Figure 65: Detail of the SAN aerial photo no. 241 of flight 524 (carried out in 1944) used during the surveys by the Palpa Project. The ample, more or less rectangular but rounded, structures of PAP-458 (upper half) and the simple dwelling sector of PAP-457 (lower half) are well visible. Both sites have a domestic LP occupation belonging to S-17. Photo: Servicio Aerofotográfico Nacional, marking of site borders by the Palpa Project.

In the Viscas valley, two further settlements were fortified. These are S-19 at PAP-671 (Viscas Viejo) and S-18 at PAP-628 and some adjacent sites (La Capilla). S-19 occupied a small hill at the mouth of a wide *quebrada* fan, which was protected towards the more easily accessible east by a wall-ditch system. This is not preserved well but sling stones can still be found nearby and leave no doubt about the defensive character of the structure. The principal sector at the very top once showed the rests of some well-built stonewalls forming rooms and terraces, but these are hardly recognizable today due to recent heavy looting. It is very possible that already during Late Paracas, the area was connected to the Ingenio valley by a trail leading along the eastern margin of the deserts *pampa* to the Estudiante site (site 455, Silverman 2002:78-81).

S-18 at PAP-628 (La Capilla) is situated at a strategic location, controlling a trail across the mountains to the Palpa valley (Figure 66). This is probably the reason why the same location was also chosen in later phases for the establishment of important settlements. Accordingly, large parts of the lower sectors of S-18 are buried by younger occupations but the hilltop part of PAP-628 including the completely terraced southwestern slope seems to have been settled predominantly during Late Paracas. Some terrace walls that follow the natural contour lines have partly collapsed by now and are

¹⁰⁹ To the southwestern extreme, some large rectangular structures can be observed, but these are much younger and date to the LIP.

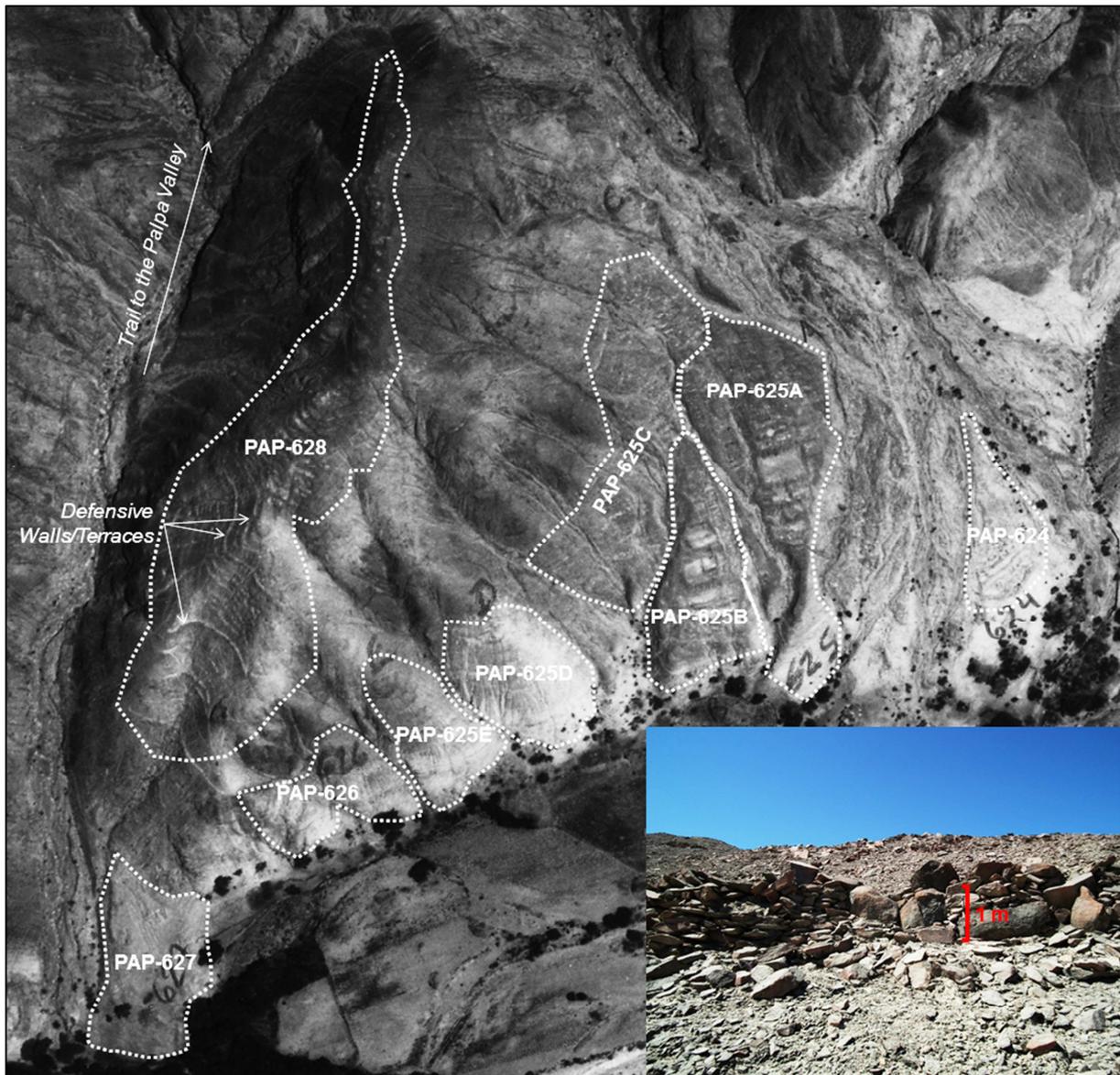


Figure 66: La Capilla (PAP-624-628) on the SAN photo 524-498. The large rectangular structures of PAP-625 A and B date to Nasca times while most structures of PAP-628 seem to have been erected in Late Paracas, namely, at least three extraordinarily massive terraces with apparent defensive functions (inlay). Photo: Servicio Aerofotográfico Nacional. Inlay photo: VS.

heavily eroded but may once have stood more than two meters high, judging from the quantity of debris (Figure 66, inlay). As the presence of sling stones suggests, they may have served defensive purposes. The terraces surrounding the top formed the bases of rounded-rectangular dwelling units, partly carved out of the rock and very similar to those of Pinchango Viejo but slightly larger on the average.

In the upper Palpa valley, another two settlements, S-1029 at PAP-576 and S-1040 at PAP-583, follow this pattern. In both cases, the hilltop was protected by walls against the adjacent mountain spurs while the access from the valley floor was not restricted. S-1302 at PAP-1089 also included a small hilltop sector (PAP-1088) but this one does not seem to have had defensive functions. In the upper Viscas valley, S-1226 at PAP-588 and S-1227 at PAP-586, both located on the lower slopes, were unprotected settlements.

About a dozen large villages were designed as hilltop settlements at the *cabezas*, some with additional fortification walls and others relying on the steep terrain for natural protection. The terraces were generally arranged in a concentric pattern around the highest point. Since the outermost retaining walls often were especially high, they also served for defensive. The houses were mostly circular but may have deviated from this shape where the terrain was too steep or the terraces were too narrow.

The most striking feature of almost all important Late Paracas settlements at the *cabezadas* and in the upper valleys are the flower structures, which had already been mentioned in Chapter 6.4.2.1 because they first occurred in some Middle Paracas villages. However, they were more widely distributed during the Late Paracas phase. From 2008-2012, the Palpa Project performed major excavations at Cutamalla (PAP-767) where several partly overlapping structures of this type belonging to S-71 had before been recognized on the ground and in aerial photos (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013). The excavations revealed that the flower layout does not seem to be bound to a certain function of the structures. Dwellings may be arranged in this manner around a central, often sunken, plaza but in other cases, the “petals” have further internal subdivisions, banquets, and other features not common in habitation units (Figure 74). Furthermore, these features can vary slightly from petal to petal, even though they belong to the same flower. At Cutamalla, tools and waste related to activities like textile production and stone working were found in and around them, suggesting an industrial function. There is nevertheless evidence that remodeling during succeeding construction phases went along with changes in usage.

Whatever the diverse functions, it is obvious that flowers only occur in the larger and more important settlements. On aerial photos taken in February 2013, flowers also became visible at PAP-1077 (Collanco), belonging to the Late Paracas settlement S-1757. This observation has very recently been confirmed by excavations in 2013. The structure chosen for excavation contained clear evidence for domestic use (Markus Reindel, personal communication). Figure 67 shows the setting of the site and an overview over the recent excavations. At the *cabezadas*, further examples of Late Paracas settlements containing flower structures are S-157 at PAP-812 (Chaki Qocha), S-197 at PAP-842 (Cusuru), S-113 at PAP-774 (Musuq Cancha), S-164 at PAP-814/815 (Huayuncalla), S-141 at PAP-800 (Cabrancha), S-147 at PAP-807 (Pariaccacca), and S-1706 at PAP-894 (Malma). In some other cases, bad conservation and vegetation cover do not permit easy recognition of flower structures without excavation.

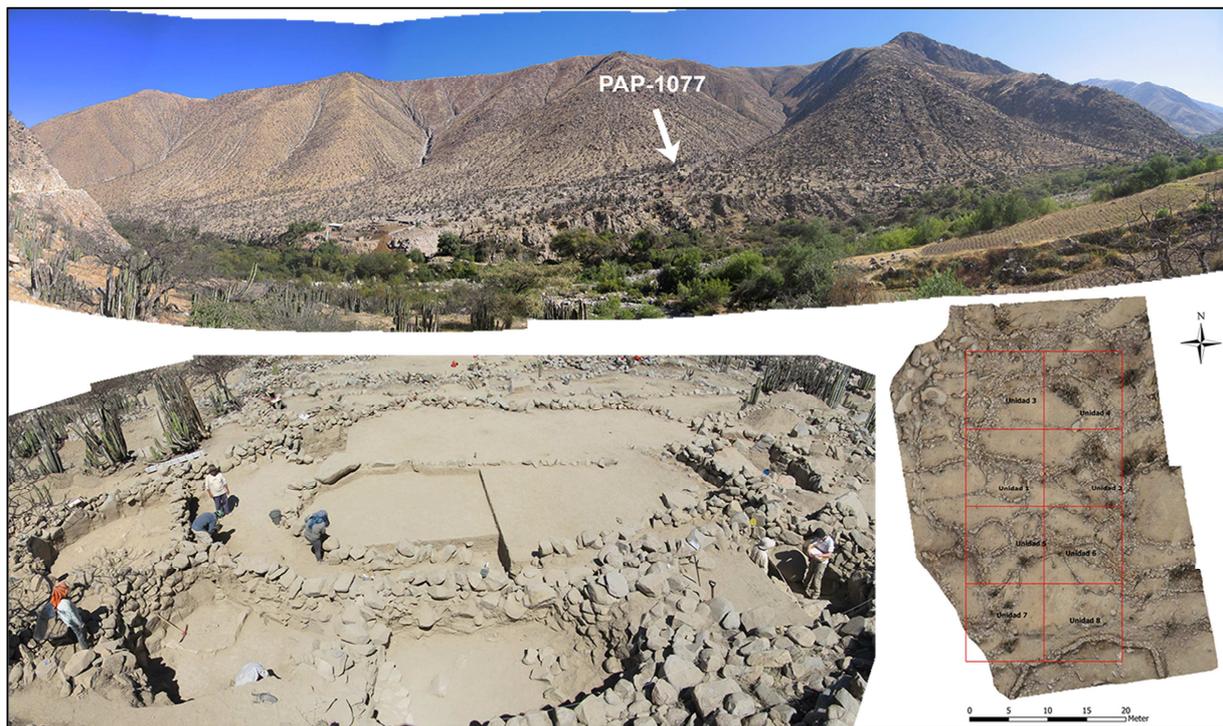


Figure 67: PAP-1077 in the Collanco section at the transition between the upper Palpa valley and the *cabezadas* of Llauta. One flower structure has been excavated recently in 2013. Panoramic photo at top: VS. Photo on lower left: Markus Reindel. Overview plan of excavation units on lower right: Palpa Project.

S-70 at PAP-770 (Quechqalla) deserves a special mention. The settlement was established on two neighboring hilltops connected by a ridge (Figure 68). On the southern top (sector A), at least three flowers with a diameter of about 20 m are easily recognizable, even on satellite images. There were probably more of these structures which today are largely overgrown or buried under debris. Most observable walls are double-faced and well-built. Despite the hilltop position, this sector is accessible from the east. Sector B on the other top, in turn, is only accessible via the connecting ridge at the end of which there is a massive wall restricting passage. In addition to this obvious defensive measure, the

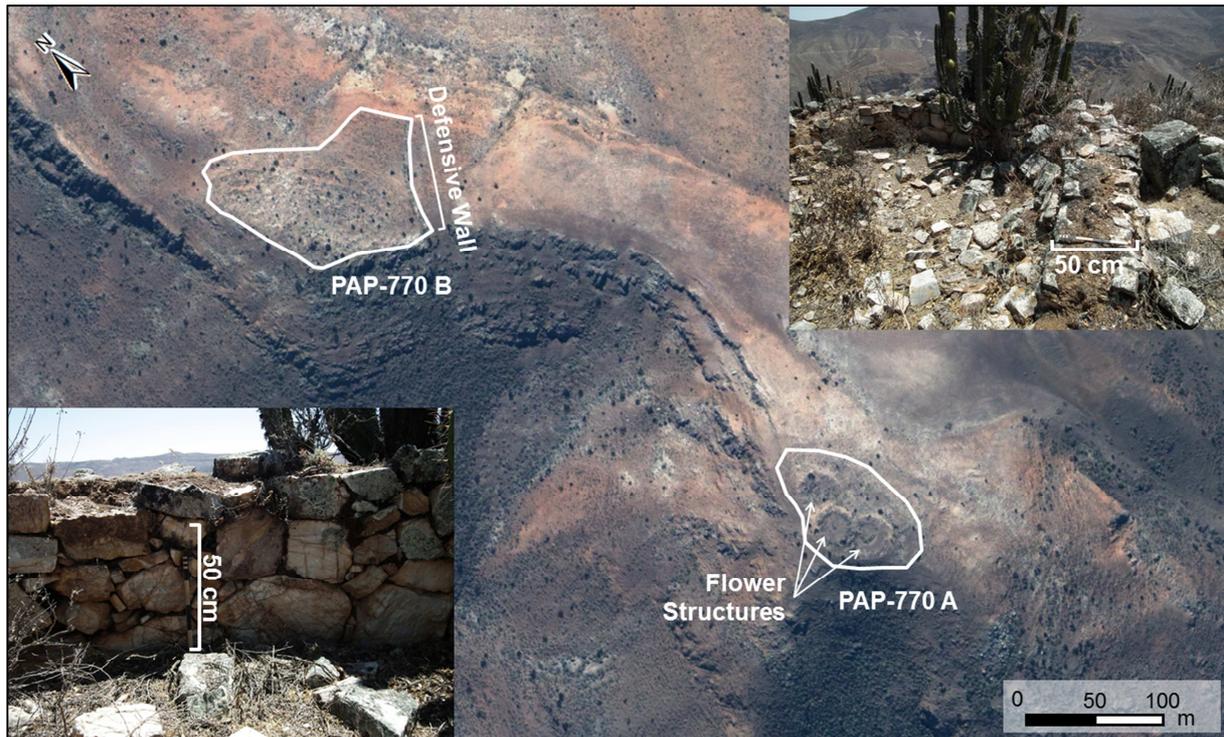


Figure 68: PAP-770 (Quechqalla). Most of the site belongs to the Late Paracas settlement S-70. The settlement had a sector with flower structures (sector A) and a second one which seems to have served as an acropolis. It is secured by a long, thick wall, complementing the natural protection by the steep slopes. The walls of the houses and terraces are mostly double-faced and built of carefully chosen, well-fitting stones. The quality of the execution is clearly above average and suggests a prominent status of the settlement (upper right and lower left corners). Aerial photo: DigitalGlobe (Quickbird). Inlay photos: VS.

fine masonry of the numerous dwelling structures built on concentric rings of terraces suggests a high status of the settlement. The place was clearly chosen for strategic considerations, not only with regard to its defensibility but also for the excellent visual connection to other important LP settlements in the area, such as S-71, S-147, S-155, and S-164.

S-141 at PAP-800 (Cabracancha) also contains traces of flowers as well as a possible defensive wall. It is also one of the few LP settlements associated with a number of large enclosures, interpreted as pens. Unfortunately, all structures are badly preserved because the stones have been removed by present-day shepherds to build pens. Only the foundations remain (Figure 70).

6.4.3.2. Settlement Location and Subsistence

During the Late Paracas phase, settlement density increased in all sections of the study area (Map 17). The relative distance and altitude patterns (Figure 69) were similar to that of the preceding phase, with the only difference being the disproportionate increase in villages located at less than 20 hours walking distance from the coast. This reflects the settlement of the great floodplain and the middle valleys. At the *cabezas*, the pattern did not change much.

The intense colonization of the middle valleys is striking. In this area below the 1000-m-contour, rain-fed farming cannot have been practiced, even if conditions were less arid than today. Accordingly, small-scale irrigation was probably applied to cultivate the valley floors. At this altitudinal zone, all sorts of *yunga* products such as cotton and a variety of fruits could be grown.

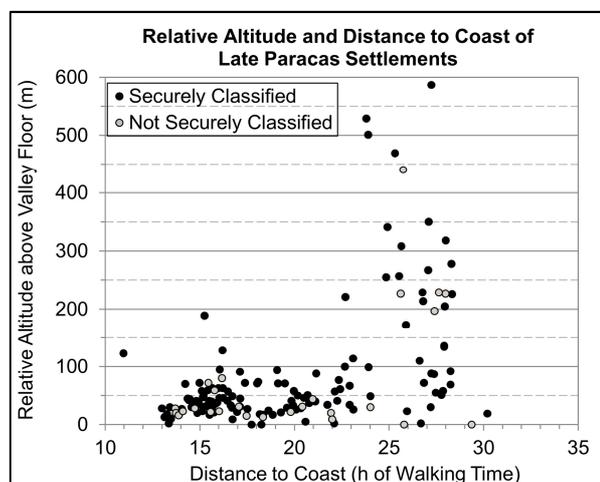


Figure 69: Relative altitude above the valley floors and walking time distance to the coast for Late Paracas settlements. Graphic: VS.



Figure 70: S-141 at PAP-800 (Cabracancha) is one of relatively few Late Paracas settlements with a number of large enclosures which probably served as pens for llamas and alpacas. In the center of the photo, pens are visible which were constructed by present-day shepherds but on ancient foundations and using stones partly taken from other pre-Hispanic structures. In consequence, the latter generally only preserve their foundations. The stone lines seem to offer favorable growing conditions for some species of shrubs and thus their location is marked on the photo by the vegetation development. The settlement was protected by a massive wall that still preserves about 50-70 cm in height but should once have been higher (upper left). Photos: VS.

Cotton may have become more important as a raw material for plain cloth as well as for finely worked multicolor artworks such as those excavated by Tello and Xesspe at Cerro Colorado on the Paracas peninsula (Tello et al. 2005 [1959]/2009, Tello & Mejía Xesspe 1979). The great plain also became colonized more densely, presumably for the same reason.

The upper Palpa valley also seems to have attracted LP settlers, although the valley floors are relatively narrow. Perhaps the climatic conditions at this time and altitude were especially favorable for some crops. Interestingly, S-1040 at PAP-583 is associated with agricultural terraces immediately below the domestic sector (Figure 71). Since these do not preserve any recognizable traces of irrigation canals, they have likely been cultivated relying on local rainfall. S-1040 lay at an altitude of only 1280 m.a.s.l., which is roughly a thousand meters below the present-day altitudinal limit for this farming method but still well within these limits under semi-arid conditions (see Chapter 4.3). If small channels once existed they were probably not fed by the river but by the broad *quebrada* delimiting PAP-582 to the east. This *quebrada* reaches up to 2000 m.a.s.l. and could have been fed by precipitation at this altitude.

A settlement with surrounding valley slope agricultural terraces can also be found farther upstream where S-1416 at PAP-1075, S-1757 at PAP-1077 (Collanco), and S-1302 at PAP-1089 were located at altitudes around 1650 m.a.s.l. In 2013, a canal network was identified associated with the agricultural terraces around PAP-1077 (Pablo Jimenez Salinas, personal communication).¹¹⁰ Evidence for a

¹¹⁰ If the early age of these canals proves correct, this may change the general opinion that such features were largely unknown before the late Early Intermediate Period, at least on the South Coast and the adjacent highlands (cf. Denevan 2002:172-173). On the North Coast, very old irrigated terraces dating roughly around 2000 BCE were identified at La Galgada in a lateral valley of the Santa river (North Coast, Grieder et al. 1988:144). They may represent a local adaption to the steep valley margins and the frequent flooding of the valley floors rather than an example of an already widely used technology.



Figure 71: Agricultural terraces at PAP-582, which were probably fed by local rains. Photo: VS.

connection to the Palpa river, however, is still missing. Apparently, the network served to control and to distribute the runoff caused by *local* precipitation. Accordingly, rain-dependent farming can be assumed, perhaps complemented by *quebrada* irrigation. The lack of agricultural terraces in the upper Viscas valley may be explained by the generally steeper slopes. Cultivation here seems to have been limited to the valley floors.

At the *cabezadas*, remains of agricultural terraces are present almost everywhere, although generally neither the phase of their construction nor the time span they were in use could be determined. It is nevertheless likely that a good number of them were cultivated by the people living in the nearby LP settlements.¹¹¹ Evidence of pens associable with herding is comparatively rare. As stated for the preceding phase, pastoralism does not seem to have been a major economic activity but rather was of secondary importance.

6.4.3.3. Hierarchy and Defensive Measures

For the Late Paracas phase, 130 out of 165 villages (52.2% of the total settlement area) were classified as common settlements and 19 (35.3%) as simple centers (Figure 75).¹¹² Additionally, for the first time there were four settlements which can be regarded as local centers, covering 11.6% of the total area. These were S-16 at PAP-11 (Pinchango Viejo) and S-18 at PAP-628 (La Capilla) at the foothills, and S-71 at PAP-767 (Cutamalla) and S-164 at PAP-770 (Quechqalla) at the *cabezadas*. In all four cases, a special need for protection becomes apparent in the choice of difficult-to-access locations and the construction of defensive walls (with the exception of Cutamalla). Furthermore, structures were larger or of better quality than in simple centers. This alone cannot be regarded as evidence for any formal hierarchy, but a certain status differentiation among the more important settlements seems to have taken place and it can be assumed that the elites residing in these four places had more prestige and power than their neighbors and perhaps even formally held sway over them. In neither case is control over an extended territory probable. S-16 and S-18 may have dominated the middle Palpa and Viscas valleys, respectively. S-71 and S-164 lay so close to each other that they could have formed part of the same domain rather than competing with each other.

There must nevertheless have been conflict as the clear trend towards hilltop settlements (Figure 69) and the presence of numerous defensive walls plus sling stone deposits (also at the foothills) suggests.

¹¹¹ Some may even have been constructed during the Middle Paracas phase.

¹¹² The 12 non-permanent settlements taken together only account for 0.9% of the total settlement area and are negligible.

Though suitable for preventing and repelling surprise attacks by small raiding bands, such devices hardly would have held up against a prolonged siege or against the onslaught of a well-organized army. Occasional raiding by close neighbors therefore is a much likelier scenario than large-scale warfare.

It is striking that at the foothills defensive measures are always directed against the mountains while there was apparently little concern about attacks from the valley side. Perhaps, the forest of *huarango* trees and spiny shrubs along the rivers was still relatively dense and provided natural protection, although settlement density suggests a massive clearing of the valley floors for cultivation. Even today, where most of the original riverine forest has been cleared, walking is difficult in some sections of the valley floor. There are only a few narrow trails, often ending suddenly at a small cleared and cultivated patch. Staying oriented is hard because the trees and shrubs restrict sight and beating a path off-trail right across the underwood is difficult, time consuming, and thanks to the many thorn-armed plants, fairly painful. Accordingly, there is good reason to assume that the preferred tracks – for transport caravans as well as for raiding parties – were those along the vegetationless ridges from where the valleys can be accessed by following one of the smoother lateral spurs. Walls were often placed at the narrowest spot of such spurs, above the settlement they protected.

6.4.3.4. Major Inter-Phase Developments

The Late Paracas phase excellently illustrates why lumping together all settlements assigned to the same phase is problematic, especially when interpreting population development. Although the number of LP settlements (165) is the second highest of all phases, most villages did not have direct precursor or successor occupations and hence must have been rather short lived. Only 39 villages with a combined area of 40.9 ha existed at phase start while 63 with a total of 65.35 ha were occupied at phase end (Figure 75). This translates into a relatively moderate growth of 59.8%, compared to the 586% during Middle Paracas. Assuming a steady development, the average yearly growth rate would be about 0.39%, though the uncertainties about the phase length lead to an immense margin of error, between 0.5%-1.58%. The rate is moderate in any case and can be explained by normal population growth without significant impact of immigration from outside the study area, if sheer numbers are considered.

It is nevertheless possible that population peaked around the midpoint of the phase and then quickly dropped again. If most of the 72 villages with neither a direct precursor nor an immediate successor were occupied simultaneously, then a scenario of massive immigration from outside the study area leading to a sudden population rise becomes probable. However, many settlers would have left again only decades later. Unfortunately, the resolution of the available settlement data is too low to reflect such short-term developments.

The development of settlement distribution also is noteworthy. From the overall picture (Map 17), it could be concluded that during the Late Paracas phase equilibrium was reached between foothill and *cabezadas* colonization and that the inhabitants of both areas exchanged *yunga* and *quechua* products. This conclusion turns out to be misleading when comparing phase start and phase end. Maps 16 and 18 show very clearly that most highland and foothills villages were not occupied simultaneously. Generally speaking, the former were inhabited at the beginning and the latter towards the end of the phase. Accordingly, the dislocation rate of 90.2% is the highest of all phases. The shift is also reflected in the relative distance and altitude diagrams (figures 62 and 72). Settlements in the beginning were distributed more or less evenly at walking distances between 15-30 hours, but at phase end the overwhelming majority was located at distances between 13-23 hours.

Something must have happened during Late Paracas that triggered large-scale migration. The question is, whether highland dwellers simply

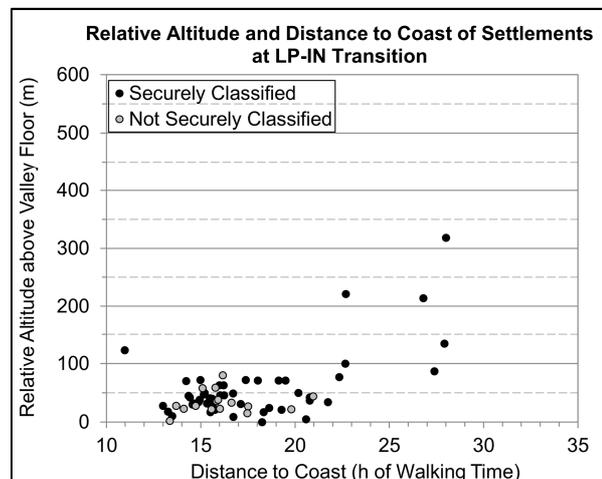


Figure 72: Relative altitude above the valley floors and walking time distance to the coast for settlements at the LP-IN transition. Graphic: VS.

founded new villages in the middle valleys or if they left the study area while immigrants from neighboring South Coast valleys moved in to occupy the foothills. The first scenario describes a dislocation of the *same* people inside the study area, while in the second a *replacement* would have taken place. Bearing in mind the evidence for defensive measures at many settlements and the general discussion about a possible migration wave from the northern valleys of Cañete and Chíncha related to the Topará cultural tradition (Silverman 1991, Tinteroff Gil 2008, Wallace 1986) there is good reason to assume that the second scenario is more likely (see Chapter 7.4).

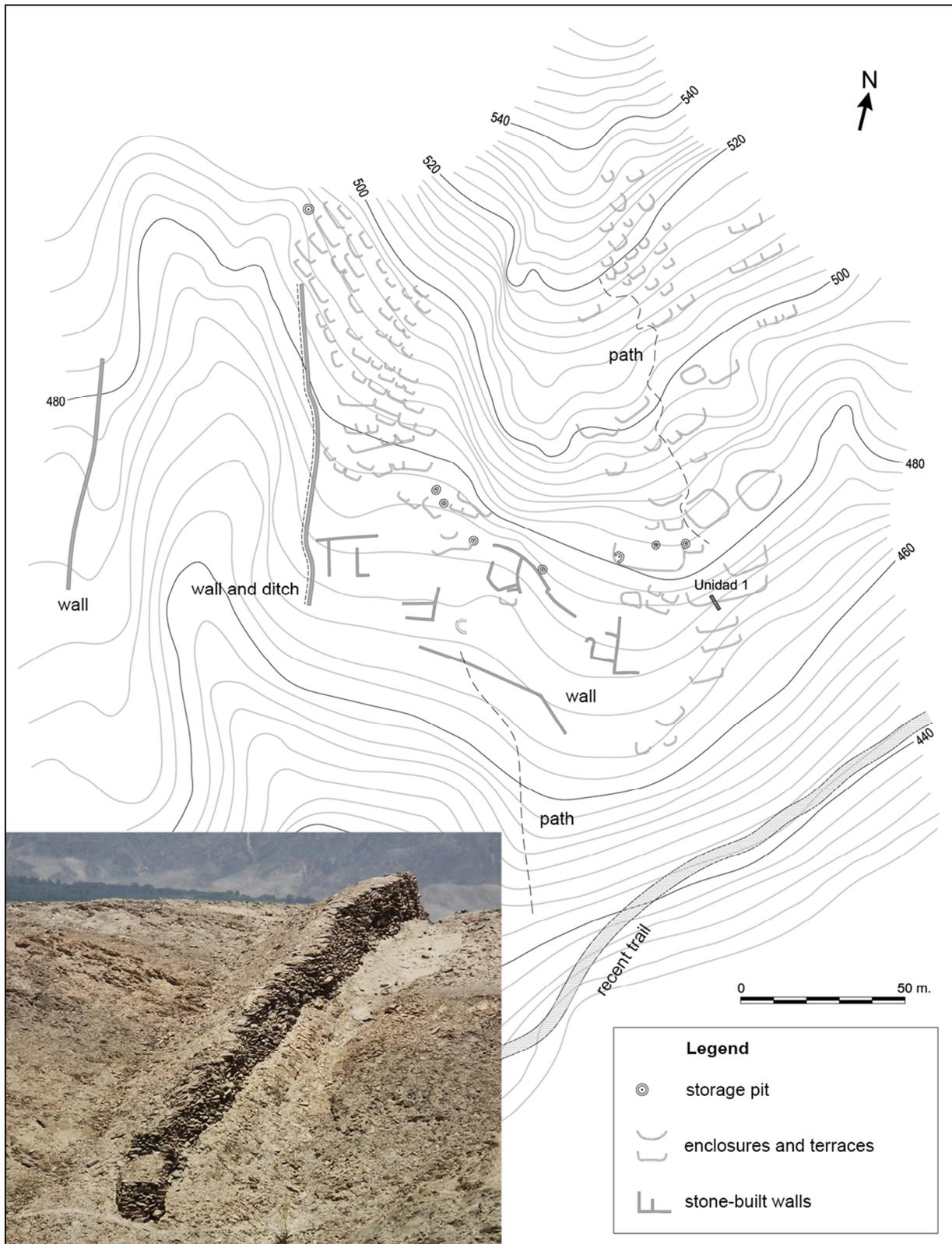


Figure 73: S-16 at PAP-11 (Pinchango Viejo). The settlement is protected by a multiple wall-ditch system. Note that the stone-built walls in the south date to the Late Intermediate Period and do not form part of S-16. The massive wall shown in the inlay picture is located about 200 m to the north of the area covered by the survey plan. Survey plan: Palpa Project, modified by VS. Inlay photo: VS.

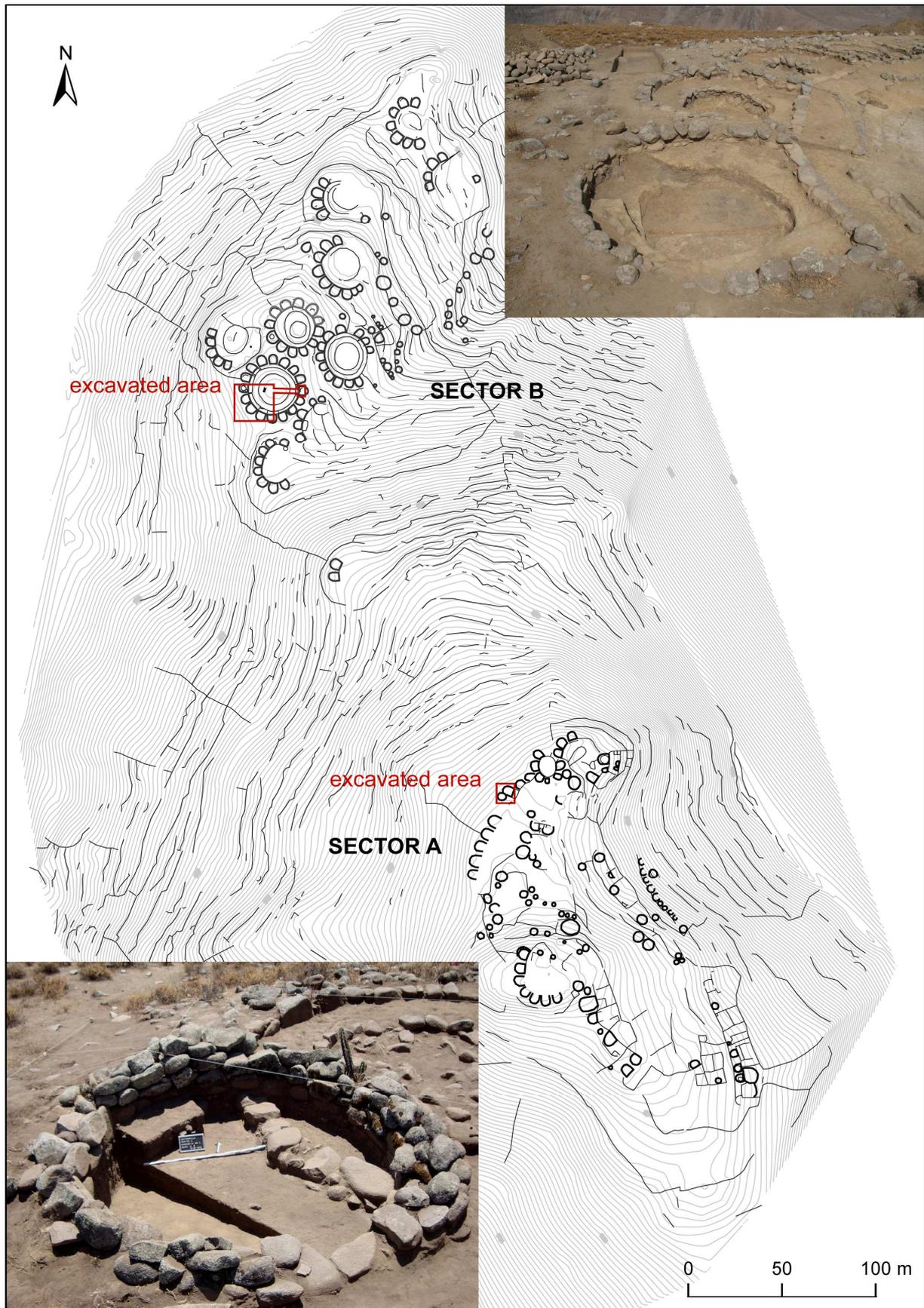
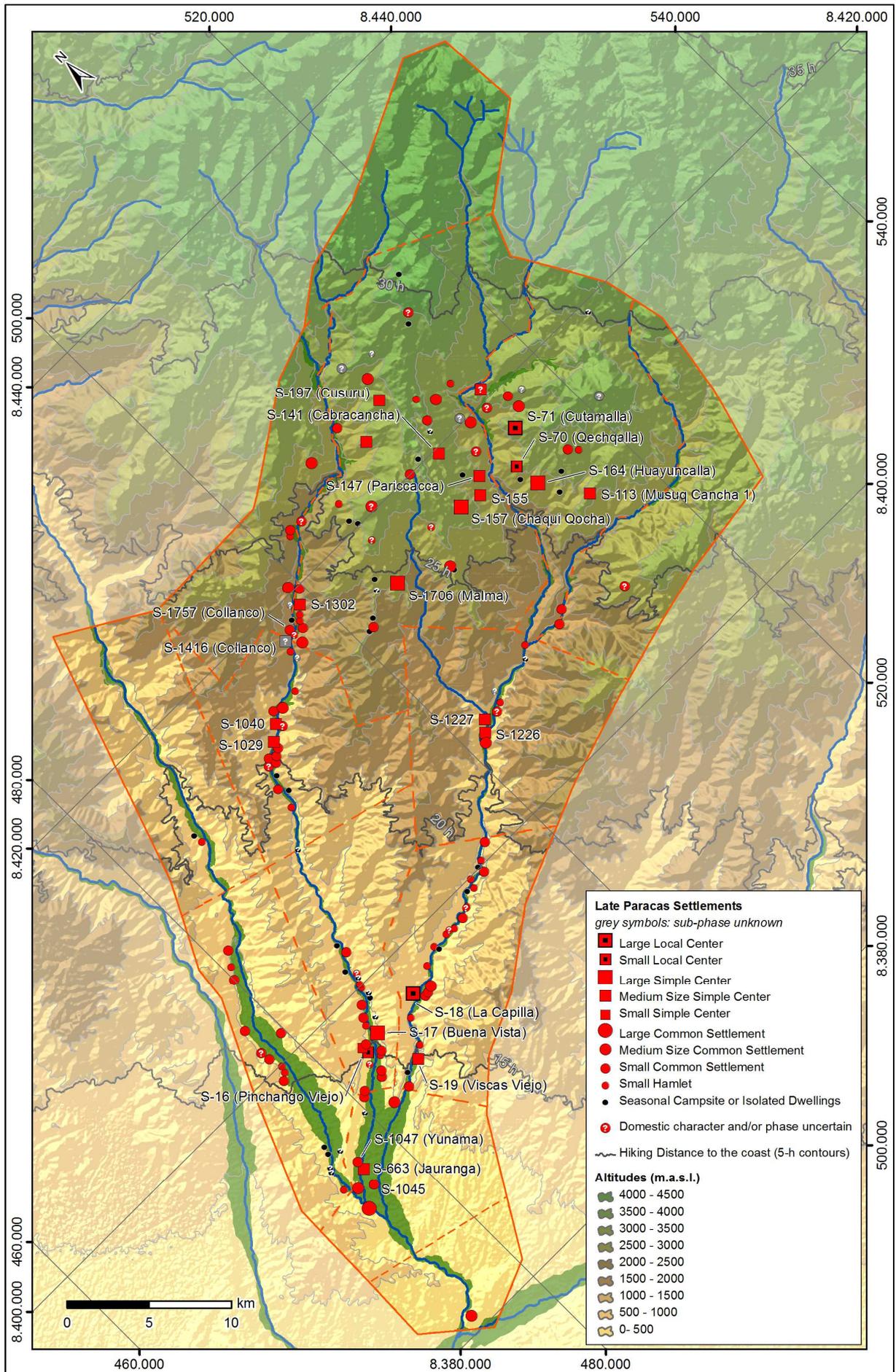


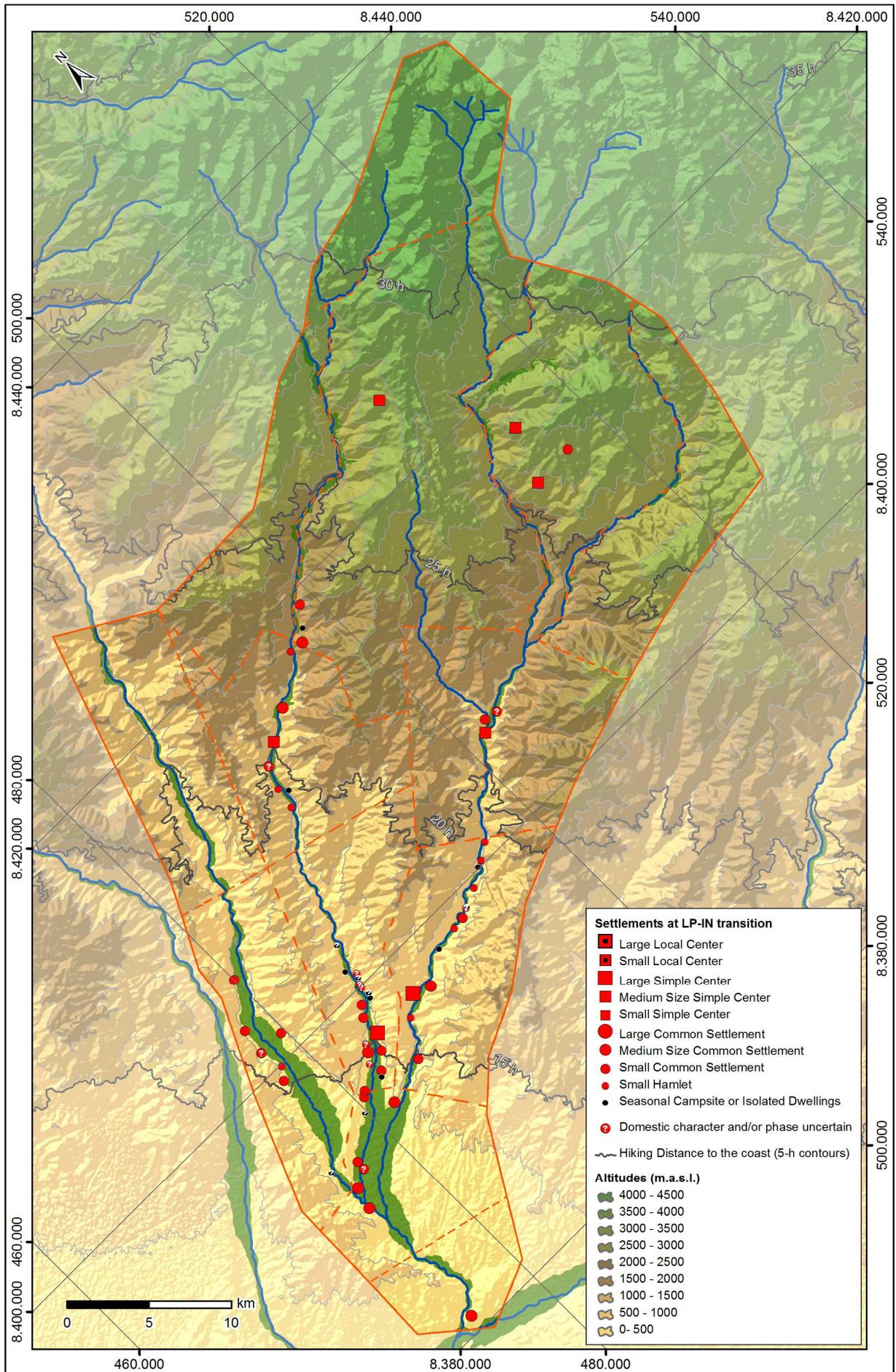
Figure 74: Survey plan of PAP-767 (Cutamalla). Upper right: D-shaped "petals" of the excavated flower structure in Sector B. Some of them had interior structures. The sunken court around which the petals were arranged could be accessed via low concentric terraces or steps which seem to have been protected by a roof as can be deduced from the presence of numerous postholes. Lower left: Domestic structure in Sector A occupied during the Initial Nasca phase superposing an older Late Paracas D-shaped "petal" belonging to a flower structure. Survey plan and photos: Palpa Project, minor modifications by VS.

Late Paracas Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
Likely date:	380 BCE	260 BCE	Likely length: 120 years
Earliest possible date:	400 BCE	330 BCE	Shortest possible length: 30 years
Latest possible date:	360 BCE	130 BCE	Longest possible length: 270 years
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
Total:	165 (135)	189.39 ha (172.58 ha)	1.15 ha (1.28 ha)
<i>b-type settlements (minimum extent):</i>	9 (5)	3.70 ha (2.10 ha)	0.42 ha (0.42 ha)
<i>At phase start (types a + bS):</i>	39 (20)	40.89 ha (32.64 ha)	1.05 ha (1.63 ha)
<i>At phase end (types bE + c):</i>	63 (53)	65.35 ha (59.73 ha)	1.04 ha (1.13 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	72 (67)	71.98 ha (65.38 ha)	1.00 ha (0.98 ha)
Growth and dislocation			
Area net growth:	24.47 ha (27.09 ha)	59.8 % (83.0 %)	
Dislocated area:	36.89 ha (30.24 ha)	90.2 % (92.7 %)	
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
Area growth per year:	0.39 % (0.50 %)	1.58 % (2.03 %)	0.17 % (0.22 %)
Population Index:	1.58 (1.44)	6.31 (5.75)	0.70 (0.64)
Status classes			
Number of settlements		Settlement area	
Non-permanent settlements:	12 (9) 7.3 % (6.7 %)	1.73 ha (1.65 ha)	0.9 % (1 %)
Common settlements:	130 (104) 78.8 % (77 %)	98.78 ha (84.57 ha)	52.2 % (49 %)
Simple centers:	19 (18) 11.5 % (13.3 %)	66.86 ha (64.33 ha)	35.3 % (37.3 %)
Local centers:	4 (4) 2.4 % (3 %)	22.03 ha (22.03 ha)	11.6 % (12.8 %)
Administrative posts:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Administrative centers:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha)	0.0 % (0 %)
Population size classes			
Number of settlements		Settlement area	
Isolated dwellings:	37 (25) 22.4 % (18.5 %)	3.48 ha (2.37 ha)	1.8 % 1.4 %
Small hamlets:	38 (31) 23.0 % (23.0 %)	12.34 ha (10.30 ha)	6.5 % 6.0 %
Small settlements:	52 (43) 31.5 % (31.9 %)	44.83 ha (36.59 ha)	23.7 % 21.2 %
Major settlements:	31 (29) 18.8 % (21.5 %)	82.15 ha (76.74 ha)	43.4 % 44.5 %
Population centers:	7 (7) 4.2 % (5.2 %)	46.58 ha (46.58 ha)	24.6 % 27.0 %

Figure 75: Basic data of Late Paracas settlements. Graphic: VS.



Map 17: All settlements of the Late Paracas phase. Map: VS.



Map 18: Settlements probably occupied simultaneously at the transition from the Late Paracas to the Initial Nasca phase. Map: VS.

6.5 The Nasca Period

By about 260 BCE, the highly dynamic cultural development in the Río Grande drainage, arguably stimulated by foreign influences, justifies speaking of the emergence of a new culture: Nasca. The transition from Paracas to Nasca, however, should be seen as a long and gradual process starting already at the beginning of the Late Paracas phase and not completed until the end of the Initial Nasca phase, some 450 years later. During the Early Nasca phase, the Río Grande drainage saw its cultural heyday and was likely politically unified, while the Middle Nasca phase seems to have been a time of fragmentation. Towards the Late Nasca phase, population declined and the whole region was at first only influenced and finally formally controlled by the bearers of the Wari culture who had their homeland in the Ayacucho highlands. With the arrival of the first Wari around 640 CE, the beginning of the Middle Horizon marks the end of the Nasca Period.

6.5.1 The Initial Nasca Phase (IN)

The dating of the beginning and the end of the Initial Nasca phase in the chronology established by the Palpa Project is still very inaccurate due to the gradual character of cultural transition and the limited number of only five ¹⁴C samples from only one site (PAP-73, Estaquería) (Unkel et al. 2012:2301), which suggest a phase start around 260 BCE and a phase end of around 80 CE. This would mean a phase length of 340 years but even a length as short as 170 or as long as 440 years is still within the margin of error.

During this time, foreign cultural influences and new local developments are observable, which either coexisted or merged with local traditions. This process lasted for several centuries before resulting in a new and more or less uniform material culture. In pottery, the technique of pre-fire slip painting was developed, but the older techniques of incision and post-fire painting continued to be applied concurrently. In architecture, the use of *adobe* for special buildings became more common, but stone buildings were also erected. In the NGD, the focus of settlement shifted from the *cabezadas* to the foothills, and this raises questions about changes in subsistence strategies and migration movements.

The total number of Initial Nasca settlements (149) was lower than that of Late Paracas villages (165), but the total settlement area of 224 ha was significantly higher. The average size of 1.5 ha therefore notably exceeded that of the preceding phase and constitutes the highest value of all phases (except Middle-Late Ica & Inca). The continuing trend towards larger villages also became manifest in the high share of the total settlement area occupied by population centers (37.6%) to the expense of major and small settlements (35.9% and 19.8%, respectively). The low percentage of small hamlets (5.4%) and isolated dwellings (1.3%) remained more or less unchanged (Figure 84).

6.5.1.1 Settlement Layout and Construction Techniques

Though evidence of Initial Nasca settlements at the foothills is plentiful in surface remains and was also found in many test pits at various sites, no large-scale excavation was undertaken so far to investigate the structure and architectural details of a typical village in that phase. The architecture of the Initial Nasca phase, like other cultural aspects, combines elements known from the Late Paracas culture with newly developed ones. Structures may be built of stone, like in most LP settlements, but also of *adobe*, the preferred building material in the Early Nasca phase for high-status constructions. There seems to have been a certain tendency to establish large but relatively simple settlements. In most cases, only remains of ordinary construction terraces and associated domestic refuse are visible. The leveling of natural hilltops and their transformation into more or less rectangular platforms is typical for Initial Nasca and has not been observed in foothill settlements of earlier phases. Such platforms formed part of several important settlements like S-21 at PAP-70 (Estaquería), S-23 at PAP-40 (La Máquina), S-24 at PAP-124 (Paucarrastro), and S-508 at PAP-246.

S-21 was located at the very tip of the Cresta de Sacramento, which divides the middle Río Grande valley and the great floodplain. It covered at least 11 ha but probably included the recently cultivated area between the documented site sectors as well (Figure 76). At PAP-70, up to three artificially modified hilltops are observable. Furthermore, some of the extended dwelling sectors show remains of a relatively elaborate architecture. Excavation in a 2x2 m test pit at PAP-73D revealed part of a domestic structure with double-face exterior stonewalls, several layers of clay screed floors, indicating

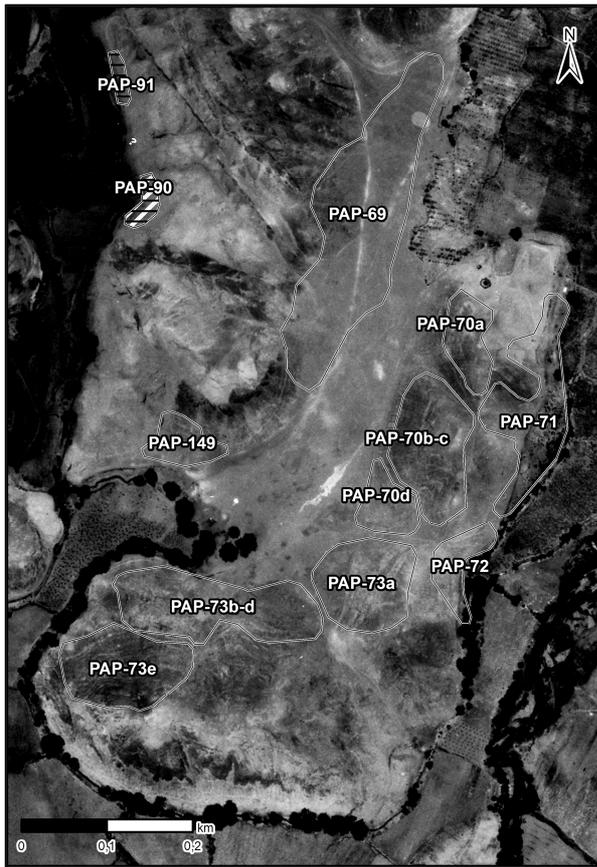


Figure 76: SAN aerial photo 524-561 showing the site sectors with a domestic Initial Nasca occupation belonging to S-21 (Estaquería). Photo: Servicio Aerofotográfico Nacional.

terry and thus has been subjected to heavy looting in recent times. The settlement continued into the directly neighboring site PAP-39, also located on a spur and a small artificially modified hilltop. Here as well the remains of terraces and structures constructed on them were more elaborate than in average contemporaneous settlements.

S-22 was in turn a large population center which once covered more than 20 ha and consisted of innumerable construction terraces, most of them probably supporting simple *quincha* huts (Figure 79). Others are more ample and show remains of subdividing stonewalls. These may have formed the bases of specialized buildings or elite residences, but in general most of the settlement seems to have been occupied by commoners. The whole area was heavily looted and partly destroyed by modern constructions. The site is also known for a cache of trophy heads from the Middle and Late Nasca phases found in the early 1990s (Browne et al. 1993).

A much better preserved example of an IN settlement on a slope is S-508 at PAP-246 on the left margin of the middle Río Grande valley (Figure 80). It represents one of the few cases of important villages of this phase that had not been reused and overbuilt later. The regular subdivided terraces are largely intact, though somewhat eroded, and would surely be suitable for excavations on a larger scale in the future. Other important settlements like S-28 at PAP-625 (La Capilla), S-1159 at PAP-621, S-737 at PAP-435 (Mollake Chico), S-523 at PAP-233, and S-569 at PAP-196 (Parasmarca) were overbuilt in later phases, so it is not clear which structures belong to the Initial Nasca occupations.

prolonged usage, and rests of a *quincha* wall which served as a room divider (Figure 77). At neighboring PAP-69, which also had a domestic occupation belonging to S-21, only traces of some *quincha* walls and domestic refuse was found in two excavation units of 10x10 and 3x5 m, respectively. Most of the cultural layers had been erased by recent tilling of the area. At the moment, all further information about settlement structure at the foothills has to rely on surface remains. As 134 of 149 IN settlements have either a direct precursor or a direct successor (or both), it is very difficult to appraise without excavation what structures date to which phase.

The settlements S-23 at PAP-40 (La Máquina) on the right margin of the Palpa valley just where it opens into the great floodplain and S-22 at PAP-285 (Carapo) almost directly opposite at the junction of the middle Palpa and Viscas valleys may have formed a functional unit. At S-23, the relatively elaborate and larger-scale structures indicate the existence of a sector with public, administrative, or otherwise representative functions (Figure 78). There are several larger platforms (up to 4x12 m in size) arranged in a stairway fashion, one above the other and ending in a hilltop that was artificially leveled and shaped to a roughly rectangular form. The part below the platforms is an elevated and largely non-artificial terrace with remains of several elaborate stone structures or structures with stone foundations. This area was used in later phases as a cemetery and thus has been subjected to heavy looting in recent times.



Figure 77: Stonewalls with clay mortar belonging to a domestic structure of S-21 at PAP-73. Photo: Palpa-Project.



Figure 78: The site PAP-40 (La Máquina) which formed part of S-23. The small hilltop at the center left had been artificially leveled and modified. Below, a number of large and elaborate terraces can be seen. The lowest part still shows some remains of double-face stonewalls but heavy looting seriously damaged or destroyed much of the archaeological evidence. Photo: VS.



Figure 79: SAN aerial photo 524-557 showing the site sectors at Carapo with an Initial Nasca domestic occupation belonging to S-22 (Carapo). The total settlement area exceeded 20 ha. Photo: Servicio Aerofotográfico Nacional.



Figure 80: S-523 at PAP-246. The image shows the well preserved structures and terraces of sector B (foreground) and a leveled hilltop platform of sector A (background, upper right). Photo: VS.

The settlement S-26 at PAP-460 (Mollake Grande) differed from all other contemporaneous foothills villages by its location high in the mountains at 220 m above the valley floor. It is only accessible by a small and easy-to-control path departing from the large settlement S-859 (Buena Vista) located in the left margin of the middle Palpa valley. Given their close proximity, it seems likely that S-26 and S-859 formed a functional unit with most of the high-status buildings located at S-26 and the major common dwelling sectors at S-859. The trail passes several small pits where present-day informal miners searched for gold. Some of these pits show traces of previous pre-colonial exploitation, partly dating back to Nasca times (Reindel et al. 2013, Stöllner 2009, Stöllner et al. 2013). Nevertheless, the Nasca people might have been more interested in mineral pigments for ceramic painting than they were in metal production, as the scale of the pits is tiny and no slag deposits were found so far. At the core of PAP-460 stretch extended dwelling sectors with terraces and small domestic units while in the lower parts there are a number of low, large, and regular platforms that probably served ritual or administrative purposes and not domestic activities (Figure 81). A number of walls belonging to elaborate rectangular structures are also visible, some still preserving up to 1 m in height.

There is no difference in general construction patterns if comparing settlements around the great floodplain and in the middle valleys to those in the upper valleys. For example, in case of S-1616 at PAP-588, where no occupation from later phases has been observed, some terraces and stone structures are exceptionally well preserved but show the same roughly rectangular forms as other IN settlements farther downstream.

Only few IN settlements are known from the *cabezadas*, most of which were founded in the preceding phase but stayed occupied for some time before being abandoned. Of these the three largest were S-195 at PAP-842 (Cusuru), S-102 at PAP-767 (Cutamalla), and S-1761 at PAP-814 (Huayuncalla). Apparently, no new flower structures were built and the existing ones were remodeled and sometimes used for different purposes. This can be deduced from the excavations at PAP-767 (Cutamalla) (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013). In sector A (the upper, southern part of PAP-767) excavations revealed a superposition of an older flower structure associated with Ocucaje 9 material and round domestic structures in which Ocucaje 10 sherds were found (Figure 74, lower left). In sector B, the interior structures of the “petals” of another flower (see Chapter 6.4.3.2) were filled and sealed by a floor during the transition from LP and IN. They had apparently lost their originally non-domestic function to be used as simple dwellings.

At PAP-814 (Huayuncalla), excavations revealed some round structures from the Initial Nasca phase that had been buried under the later Wari occupation (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013). These structures are not “petals” of a flower, but flowers are present in the unexcavated area farther west and at neighboring PAP-815. These presumably belong to the LP



Figure 81: S-737 at PAP-460 (Mollake Grande). At this site high above the Palpa valley a number of large, regular platforms (upper left) and stonewalls are still preserved up to 1 m in height. Some of these incorporate stones of extremely unequal size (upper right). The presence of large grinding stones (upper center), though also observable in other settlements, in this case could hint to the processing of minerals from the small local mines, which are still being exploited today. Photos: VS.

settlement S-164. Future excavations at PAP-814 and PAP-815 with focus on the LP and IN occupations could help to clarify if these flowers were also overbuilt or remodeled and used in another way during the LP-IN transition.

6.5.1.2. Settlement Location and Subsistence

During the Initial Nasca phase, the shift of the main settlement area from the *cabezadas* to the foothills resulted in a concentration of villages within a range of 12-23 hours of walking distance from the coast (Figure 82). The *cabezadas* obviously lost their importance as a preferred settlement area and thus arguably also as a major production zone. Instead, many new villages were founded around the great floodplain and at the margins of the middle valleys where the most extended terrain suitable for irrigation was available (Map 19). This suggests that a large-scale clearing of the *huarango* forests at the valley floors began and that larger and more sophisticated irrigation canals were constructed. Nevertheless, these will have been much more modest in size than those known from the North Coast. Only rarely were traces of canals preserved in the archaeological record, and where

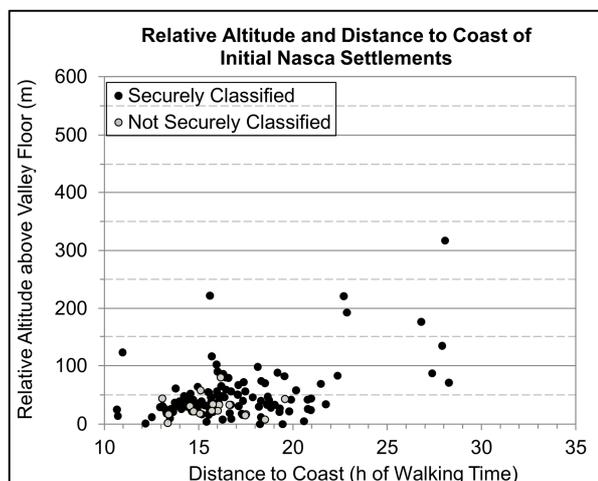


Figure 82: Relative altitude above the valley floors and walking time distance to the coast for Initial Nasca settlements. Graphic: VS.

they are the time of construction and use is difficult to determine. Most of the ancient irrigation network has probably been destroyed by centuries of subsequent domestic and agricultural activities, and especially by the usage of heavy machinery to flatten the valley margins in order to gain additional cultivable land since the 1950s. The location of settlements therefore can only give an indirect hint that the surrounding areas were probably used as irrigated farmland. The presumed clearance of valley forests must have limited the potential for hunting and foraging at the foothills while the abandonment of the *cabezadas* drastically reduced the supply of highland crops, especially tubers, and of camelid wool and meat. Only two settlements, S-182 at PAP-831 (Sayhua Pata) and S-138 at PAP-796, are associated with pens.

There is no reason to assume that the closer proximity to coastal resources could have been a major motivation for the shift of settlements to the foothills, because the lower Río Grande valley, from where the distance is shortest, was not settled, except some three villages located at the junction of the Río Grande and Ingenio rivers. The inhabitants of the study area apparently relied predominantly on *yunga* crops from irrigation agriculture. According to the climate reconstruction discussed in Chapter 2.2.3, the precipitation patterns may have turned temporarily less stable during the early 2nd and early 1st century BCE, possibly resulting in multi-year droughts. These events, however, do not seem to have notably affected population density or the productivity of irrigation farming.

6.5.1.3. *Hierarchy and Defensive Measures*

Similar to the Late Paracas phase, many settlements were still located at defensible positions more than 50 m above the valley floor (Figure 82). Typical signs of conflict like defensive walls and sling stone deposits were present in Initial Nasca villages, but they were less common than in Late Paracas settlements. While concerns about raiding parties seem to have been less intense, differences in settlement status also became less pronounced. The percentage of the total area of common settlements stayed roughly the same (50.8%), but the relation of simple (44.7%) to local centers (4.5%) changed significantly in favor of simple centers (Figure 84).

Only S-23 (La Máquina) and S-26 (Mollake Grande) may classify as local centers due to their somewhat elaborate architecture although, but no other features distinguish them from simple centers. Both local centers are located close to large simple centers (S-22 and S-859, respectively) with which they may have formed a functional unit. Possibly, this constellation reflects a spatial separation between higher- and lower-status dwelling sectors. The drastic amplification of irrigation farming may have demanded a certain degree of centralization in order to organize the distribution of land and water as well as the construction and maintenance of canal systems. S-23 and S-26 may either have fulfilled different functions in the same polity – for example the former controlling floodplain cultivation and the latter mining activities – or they may have existed sequentially rather than simultaneously. During the 340 years (likely length) of the Initial Nasca phase such a relocation of the capital settlement may well have occurred.

Although simple centers appear to have been distributed relatively evenly, it is unlikely that they served as seats of small independent and competing polities. The density of villages around the middle valleys and the great floodplain without major buffer zones argues against a scenario of competition among the inhabitants of this area. The fact that the two apparently most important settlements were located at relatively close proximity in the lower part of the middle Palpa valley and at its junction with the great floodplain also suggest that this section was the center of power for all of the foothills.

The few *cabezadas* settlements were clearly spatially separated from the bulk of the foothill villages and also from the upper valleys, and they show a different construction pattern. Their inhabitants probably relied on rain-dependent highland farming and some camelid herding rather than on irrigation agriculture. They seemed to have been the last direct descendants of the LP occupants of the area though they abandoned their tradition of building flower structures. The spatial separation of the few remaining *cabezadas* from the foothills settlements argues against a political integration of both areas. The role of the upper valley settlements is ambiguous. In the Palpa and Viscas valleys, there seems to have been some kind of settlement gap which could be interpreted as an intentional buffer zone between competing polities. Accordingly, the upper valley villages possibly retained autonomy.

6.5.1.4. Major Inter-Phase Developments

Regarding the Initial Nasca phase, the difficulties in reconstructing population development become especially apparent. While the total number of settlements went down, the total area grew. The population index (the relation of total settlement area to the phase length) would have shrunken dramatically – from 1.58 to 0.66, if the likely phase length is considered. If, however, the Late Paracas phase lasted much longer and the Initial Nasca phase much shorter than is assumed, then the index could also have gone *up* from 0.64 to 1.32 (Figure 84). Both completely contradictory scenarios are within the current margin of error for the dating of the phase transitions. For this reason, it might be more reliable to compare the settlements occupied at the transitions without considering the phase length. Since the settlement area had grown by 10.8% from 65.4 at the beginning of the Initial Nasca phase to 72.4 ha at its end, the resulting annual growth rate would have been at least 0.03% and would not have exceeded 0.06%, depending on the assumed phase length. In either case, the rate would have been low.

This apparent stability in population development, however, should not obscure the remarkable dynamics in settlement distribution. In the course of the Initial Nasca phase, the *cabezadas* were abandoned completely before the end of the phase and the upper valleys also saw a major depopulation (Map 20). Accordingly, at the IN-EN transition, almost all settlements concentrated at a 13-20 hour walking distance to the coast (Figure 83). The dislocation of 58.8% is nevertheless not especially high, due to occupation continuity at many foothill settlements. Whether the *cabezadas* and upper valley dwellers moved down to the foothills or if they left the study area is an interesting question. In the latter case, other groups of foreigners, perhaps stemming from the northern South Coast valleys, must have moved in and settled the middle valleys and the great floodplain. This issue will be discussed later on in Chapter 7.5.

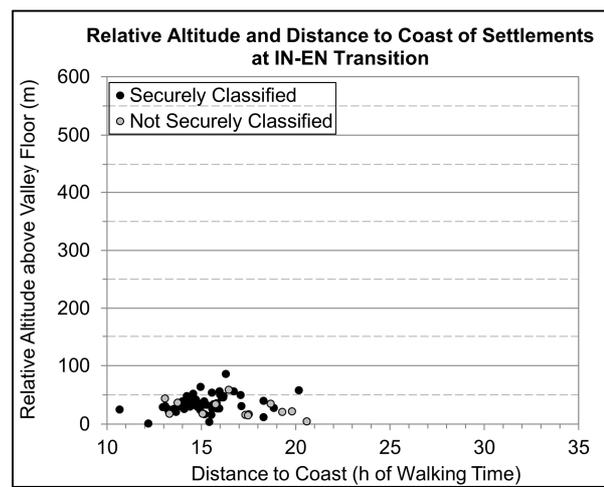


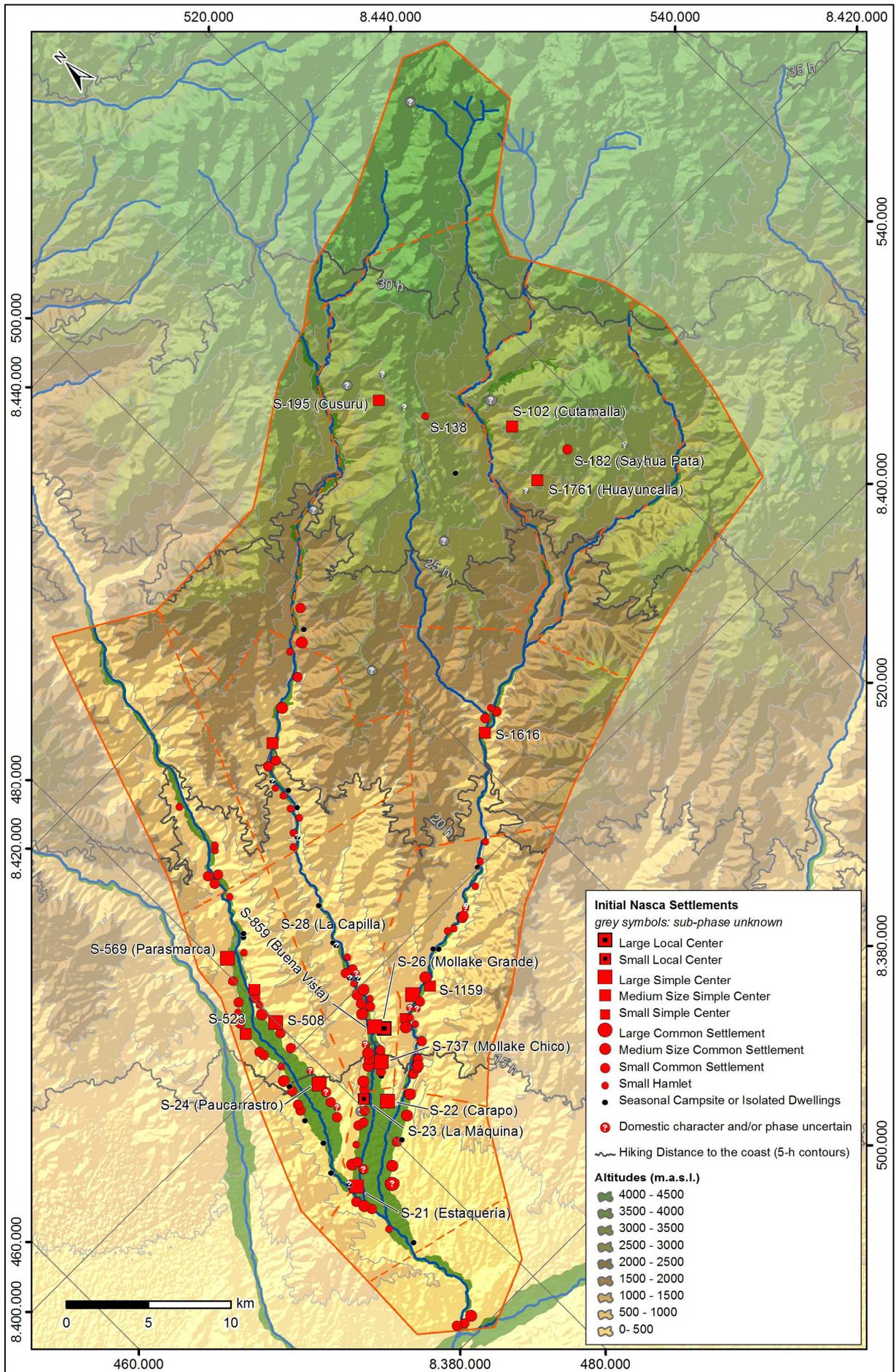
Figure 83: Relative altitude above the valley floors and walking time distance to the coast for settlements at the IN-EN transition. Graphic: VS.

The shift of settlements went hand in hand with the clearing of the valley forest. The Initial Nasca phase seems to have been the time when the inhabitants of the study area gradually gave up a diversified economy including *yunga* and *quechua* cultivation complemented by some herding, hunting, and foraging in favor of an intensified and highly productive irrigation agriculture. This type of agricultural production is restricted by the availability of irrigation water and cultivable land at the valley floors. During the Initial Nasca phase, however, neither of these limits seems to have been a serious problem; otherwise settlements would not have concentrated at the foothills.

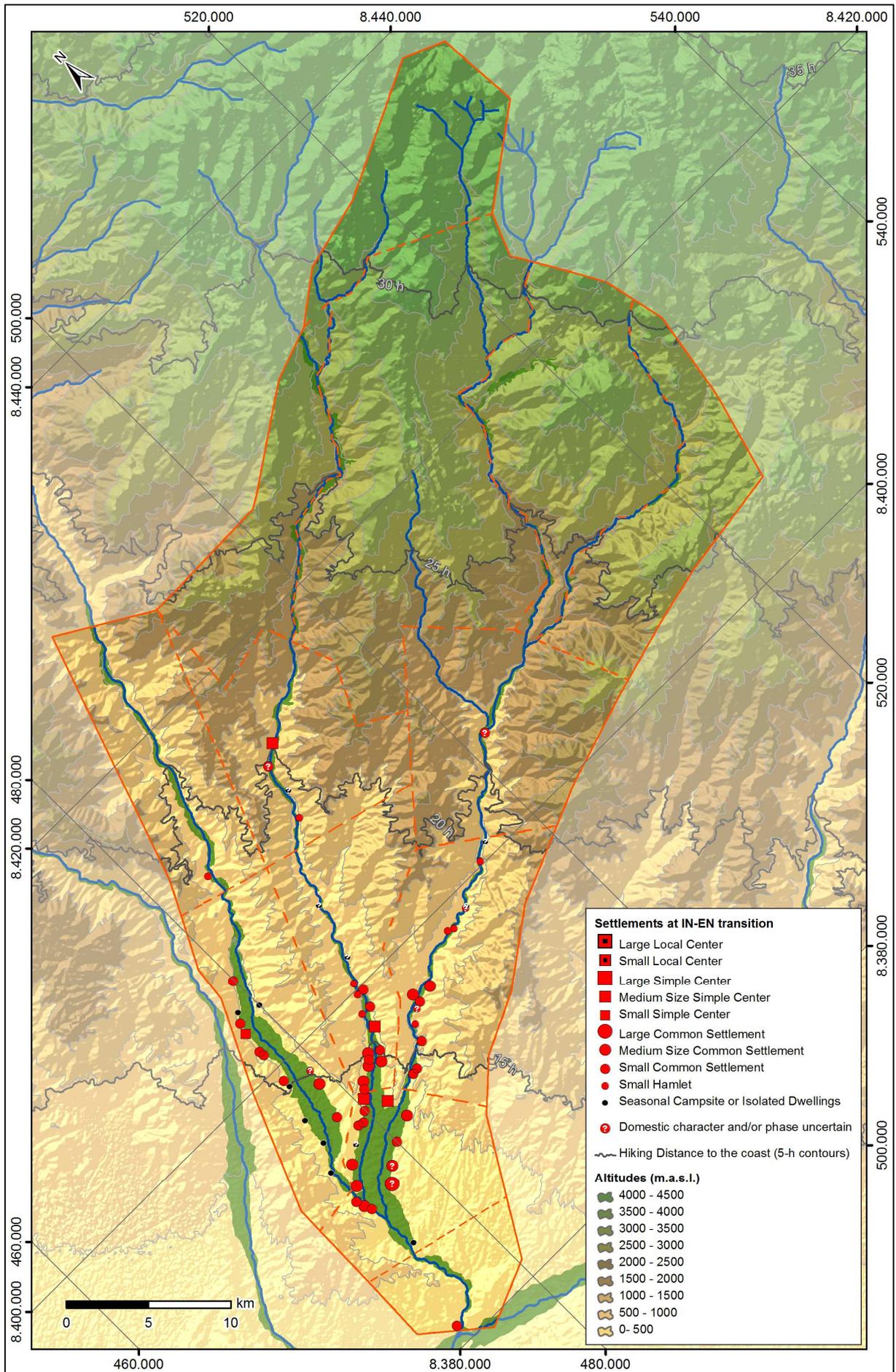
The organizational needs related to extended irrigation agriculture may have favored the establishment of a central authority and a unified foothills polity towards the end of the phase. This assumed political unification and the disappearance of possible *cabezadas*-foothills conflicts would explain the low number of settlements at the phase's end, which were located more than 50 m above the valley floor (compare Figure 69 to Figure 83). Other indicators of conflict, namely defensive walls and sling stone deposits, can also be observed predominately at villages with a Late Paracas precursor while most of those established later were largely unprotected.

Initial Nasca Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
<i>Likely date:</i> 260 BCE		80 CE	
<i>Earliest possible date:</i> 330 BCE		40 CE	
<i>Latest possible date:</i> 130 BCE		110 CE	
		Phase length	
		<i>Likely length:</i> 340 years	
		<i>Shortest possible length:</i> 170 years	
		<i>Longest possible length:</i> 440 years	
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
<i>Total:</i>	149 (132)	224.01 ha (213.73 ha)	1.50 ha (1.62 ha)
<i>b-type settlements (minimum extent):</i>	30 (22)	21.40 ha (21.13 ha)	0.96 ha (0.96 ha)
<i>At phase start (types a + bS):</i>	62 (49)	65.35 ha (62.61 ha)	1.05 ha (1.28 ha)
<i>At phase end (types bE + c):</i>	69 (63)	72.44 ha (60.81 ha)	1.05 ha (0.97 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	48 (42)	85.69 ha (80.83 ha)	1.79 ha (1.92 ha)
Growth and dislocation			
<i>Area net growth:</i>	7.09 ha (-1.80 ha)	10.8 % (-2.9 %)	
<i>Dislocated area:</i>	38.42 ha (36.08 ha)	58.8 % (57.6 %)	
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
<i>Area growth per year:</i>	0.03 % (-0.01 %)	0.06 % (-0.02 %)	0.02 % (-0.01 %)
<i>Population Index:</i>	0.66 (0.63)	1.32 (1.26)	0.51 (0.49)
Status classes			
Number of settlements		Settlement area	
<i>Non-permanent settlements:</i>	1 (1) 0.7 % (0.8 %)	0.01 ha (0.01 ha) 0.0 % (0 %)	
<i>Common settlements:</i>	129 (112) 86.6 % (84.8 %)	113.76 ha (103.48 ha) 50.8 % (48.4 %)	
<i>Simple centers:</i>	17 (17) 11.4 % (12.9 %)	100.18 ha (100.18 ha) 44.7 % (46.9 %)	
<i>Local centers:</i>	2 (2) 1.3 % (1.5 %)	10.06 ha (10.06 ha) 4.5 % (4.7 %)	
<i>Administrative posts:</i>	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
<i>Administrative centers:</i>	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
Population size classes			
Number of settlements		Settlement area	
<i>Isolated dwellings:</i>	25 (18) 16.8 % (13.6 %)	2.88 ha (2.26 ha) 1.3 % 1.1 %	
<i>Small hamlets:</i>	36 (29) 24.2 % (22.0 %)	12.00 ha (9.71 ha) 5.4 % 4.5 %	
<i>Small settlements:</i>	50 (48) 33.6 % (36.4 %)	44.39 ha (42.95 ha) 19.8 % 20.1 %	
<i>Major settlements:</i>	28 (28) 18.8 % (21.2 %)	80.50 ha (80.50 ha) 35.9 % 37.7 %	
<i>Population centers:</i>	10 (9) 6.7 % (6.8 %)	84.23 ha (78.30 ha) 37.6 % 36.6 %	

Figure 84: Basic data of Initial Nasca settlements. Graphic: VS.



Map 19: All settlements of the Initial Nasca phase. Map: VS.



Map 20: Settlements probably occupied simultaneously at the transition from the Initial to the Early Nasca phase. Map: VS.

6.5.2 The Early Nasca Phase (EN)

The Early Nasca phase is comparatively well dated, although all ¹⁴C samples originate from the site PAP-93 (Los Molinos), which again raises the question of whether the derived data is representative for the phase in general (Unkel et al. 2012:2302). The Early Nasca phase began around 80 CE and lasted for some 220 years. This era is generally considered the heyday of the Nasca culture. Early Nasca pottery, settlements, and burials are present all over the South Coast while stylistic influences and trade goods can still be found in distant regions. The production of pre-fire painted vessels was perfected, and large-scale geoglyphs were carved into the desert. Cahuachi developed into a great temple site that may well have served as the capital of a drainage-wide and perhaps even a multi-drainage polity.

In the study area, settlements were fewer in number (135) and smaller in average size (1.24 ha), compared to Initial Nasca. The total settlement area dropped by 33.7% to only 167 ha. Nevertheless, major settlements (35.6%) and population centers (33.2%) still made up for more than two thirds of the total settlement area while the remaining third fell predominantly on small settlements (21.6%). Small hamlets (7.0%) and isolated dwellings (2.5%) were much less significant (Figure 89).

6.5.2.1. Settlement Layout and Construction Techniques

The best evidence for layout and building techniques of an Early Nasca settlement at the foothills comes from large-scale excavations at PAP-93 (Los Molinos) (Figure 87, Reindel & Isla Cuadrado 2001). At this site, occupations from several Nasca phases were documented but the principal one corresponds to the Early Nasca settlement S-36. S-36 was quite obviously not a common village but a center with an elite residential sector and rooms for special purposes such as representation and ceremonies. In the central area of PAP-93, excavations revealed a number of spacious rooms (about 10x10 m) connected by doorways and corridors. The massive outer walls were up to 100 cm thick and built of *adobes* which Reindel and Isla describe as having “an oval base, a high convex body and measuring 18 to 22 cm in length, 12 to 16 cm in width, and 27 to 32 cm in height” (2001:293).¹¹³

Internal room dividers were made of *quincha*. In one room, there were the bases of wooden beams that once supported a roof. Floors were made of compacted clay covered with a layer of fine riverbed sand. Most architectural units were kept tidy, but there is also evidence of a kitchen facility with remains of a hearth and domestic refuse. The whole complex was repeatedly renewed and remodeled during the Early Nasca phase and its final abandonment was probably related to severe damages caused by heavy rains - a very unusual event in that area, even under semi-arid conditions.

Although the excavations at PAP-93 are enlightening for the understanding of high status Early Nasca settlements they tell us little about contemporaneous common dwellings. Remains of several small rectangular huts with thin *quincha* walls were found directly adjacent to the *adobe* complex but these date to the Early Wari phase and do not belong to S-36. Nevertheless, it can be assumed that common dwellings were constructed in basically the same way in the Early Nasca phase as well. In test pits at other sites with an EN occupation such as PAP-410 (Cerro Redondo) rests of *quincha* walls belonging to S-31 were found, though no complete structures were excavated. Most simple settlements only preserve remains of construction terraces but no superimposed structures. This argues for the use of light and perishable *quincha* because stone or *adobe* walls would have left easily recognizable traces.

In general, it can be said that *adobe* was considered a more noble building material reserved for high-status constructions. Accordingly, the presence of *adobe* walls is a potential indicator for the elevated status of a settlement. *Adobe* had already been in use on a minor scale at least since the Late Paracas phase. In Early Nasca, this material almost completely replaced field stone masonry, except for terrace retaining walls, which sometimes even in high-status settlements continued to be built of local rubble.

In many important settlements, especially at the left margin of the great floodplain, a common layout pattern can be observed: on the lower slopes of spurs reaching into the valley and in the broader *quebradas* between them stretched the residential and administrative sectors. Most of these have by

¹¹³ My translation. Original reads: “[...] una base ovalada, un cuerpo convexo alto y median de 18 a 22 cms de largo, 12 a 16 cms de ancho y 27 a 32 cms de altura.”

now fallen victim to recent construction and land reclamation works. A more detailed functional analysis is therefore hardly possible. Above the lower slopes where the spurs start to flatten, several regular rectangular plazas were arranged in a stairway fashion, and finally, from the highest of these platforms, geoglyphs – straight lines or elongated trapezoids – led towards the higher ridges and *pampas*. Platforms and geoglyphs probably played a role in ceremonial activities (cf. Lambers 2006).

One of the better preserved examples of this kind of pattern can be observed at PAP-352 which formed part of the extended 30 ha center S-32, just above (and partly destroyed by) the modern village of Llipata (Figure 88). The large plazas on the upper part of a spur are still relatively well preserved. Also visible are a number of *adobe* walls, especially where present-day canals and paths cut into the archaeological site. David Browne mapped the site, which he named V907, in his reconnaissance in 1990 (Browne 1992) and described it in some detail in an unpublished manuscript (Browne n.d.), but no excavations have taken place so far. The old aerial photos from 1944 reveal that the archaeological structures once also covered the *quebradas* between the spurs but these parts have been completely destroyed by modern settlers who built numerous houses and a soccer pitch in the area (Soßna 2012). Judging from the rate of demolition during the last decades, many of the important sites on the left margin of the great floodplain may completely disappear before the mid of the current century.

In addition to S-32, there were two further equally important EN settlements following the valley margin to the northeast: S-33 around PAP-332 (San Antonio) and S-34 around PAP-321 (La Falda). In both cases, most of the ancient structures clearly visible in the 1944 aerial photos have been destroyed. The settlement layout followed the same pattern as in S-32 and some remains of platform and *adobe* structures are still visible in the field. The three centers were located so close together that it can easily be surmised that they once formed a functional unit. Another – much smaller – settlement that included a stairway platform/geoglyph complex was S-37 at PAP-104 (Río Grande) at the left margin of the middle Río Grande valley, some 3 km northeast of Los Molinos. Unfortunately, the entire site was completely destroyed and is now covered by the modern village of Río Grande. It is only in evidence from old SAN aerial photos (especially 543-024) and a few traces showing up between the present-day houses.

S-35 at PAP-77/78 (El Arenal) at the right margin of the great floodplain, southeast of Estaquería, may also have followed the typical pattern. Large *adobe* platforms are still observable. However, the site reached its maximum extent and its height of importance during Middle Nasca. Test pits confirmed that most of the observable structures were erected and used during that phase. Plenty of Early Nasca sherds on the surface nevertheless suggest that the place had already been occupied before and some of the non-excavated *adobe* structures probably date to Early Nasca.

Sites in the upper valleys with important EN occupations (e.g., S-1030, S-611, and S-1304) were all in use in later phases as well so that from surface survey alone, the dating of the preserved structures is not clear. Presumably, most of them reflect the latest moment of use but may cover older constructions. In first place, the structures consisted of ordinary terraces paralleling the natural contour lines and large, rectangular platforms, sometimes presenting internal subdivisions. These platforms can be found at the lower parts of spurs while the terraces sometimes cover the whole slope. Accordingly, the arrangement seems to be the reverse of that observed around the great floodplain where the platforms can usually be found on top.

Adobe constructions have not been observed in the upper valleys. All walls were built either of stone or of perishable material such as *quincha*. Although uncooked clay can erode quickly in heavy rainfall if left unprotected, at present *adobe* constructions are common even in the rainy highland areas. If protected by a roof, this material is quite durable. This fact suggests that the preference for stone did not come about for technical reasons. Perhaps the building tradition in the upper valleys simply retained the LP/IN heritage to a greater degree than that of the lower foothills. Interestingly, not a single reliably classified Early Nasca settlement has so far been registered at the *cabezadas*.

6.5.2.2. Settlement Location and Subsistence

The density of settlements along the valley margins at 11-23 hours walking distance from the coast (Figure 85 and Map 21) implies that the trend towards a more intensive use of the great floodplain and the middle valleys for irrigation agriculture, already starting in Late Paracas, was consummated during

the Early Nasca phase.¹¹⁴ This must have resulted in the clearance of most of the remaining *huarango* forests on the valley floors. Along with the forests, the special resources they offered diminished, namely wild fruits and wood.

At the same time, the *cabezadas* and the adjacent *puna*, where different kinds of crops (particularly tubers) could have been grown and camelids herded, apparently remained unsettled. The principal economic activities seem to have concentrated on intensive and highly productive *yunga* irrigation farming. Camelid bones and coprolites, camelid wool, spines of fish, and shells of edible mussels are nevertheless in evidence in many Early Nasca contexts. These goods, however, must have been brought in from outside the study area and were most likely exchanged against *yunga* crops such as maize and cotton. Alternatively, future field work might reveal that there actually existed a number of Early Nasca settlements at the *cabezadas* which had not been recognized due to lacking diagnostic surface material. Excavations at sites with Middle Nasca remains could clarify if at least some had already been occupied in the preceding phase. To date, however, there still is no clear evidence for a noteworthy Early Nasca occupation of the *cabezadas*.

The consumption of seafood not surprisingly seems to have increased with proximity to the shore, especially southwest of the confluence of the Río Grande and Nasca rivers. Proulx reports “large amounts of sea shells, fish nets, sea urchins and other remains at Nasca sites all along the lower Río Grande and up into the other tributaries as well. Obviously the inhabitants of these small sites had access to the sea and were utilizing maritime resources on a regular basis” (2007:9).

Although *yunga* irrigation farming has always been highly productive as long as there was enough water, the one-sided focus on a single subsistence strategy was risky. In case of crop failures, the loss could not have been compensated easily by products from the *cabezadas*. If people nevertheless chose to specialize they must have been confident that neighboring regions with different resources or unaffected by failures would have supported them. If the NGD was indeed incorporated into a centralized polity that administered production and distribution of important goods of a wide area, the losses in one valley could have been compensated with surplus yields in another or with reserves stored centrally. However, given the generally stable arid to semi-arid conditions during most of the Nasca Period, such an emergency will have occurred only rarely.

6.5.2.3. Hierarchy and Defensive Measures

The status of Cahuachi in the Nasca valley, the largest and most prominent Early Nasca settlement at the whole South Coast, is still debated. Though there is general agreement that it had a superregional importance for people associated with the Nasca culture all over the South Coast, theories about its function range from “pilgrimage center” (Silverman 1993) to “capital of a centralized state” (Rowe 1963, Strong 1957). The archaeological data from the NGD fits better into a scenario of an Early Nasca multi-valley political entity into which the study area was incorporated.

No defensive measures are observable in Early Nasca settlements. The few villages located more than 50 m above valley floor level (Figure 85) were nevertheless relatively easily accessible. These may not have been established in elevated places for the sake of defensibility but perhaps for a better overview or because suitable construction ground was lacking closer to the valley floors. The two extremes in Figure 85 are S-1709 at PAP-873 (Suito Orqo) and S-1409 at PAP-1065, but in both cases the evidence for the respective Early Nasca occupation is sparse and does not allow a reliable chronological classification. No Early Nasca settlement shows deposits of sling stones or defensive walls, though in some cases single sectors may have been enclosed by perimeter walls and thereby separated from the rest of the respective settlement, as in case of the central sector of S-36 (Los

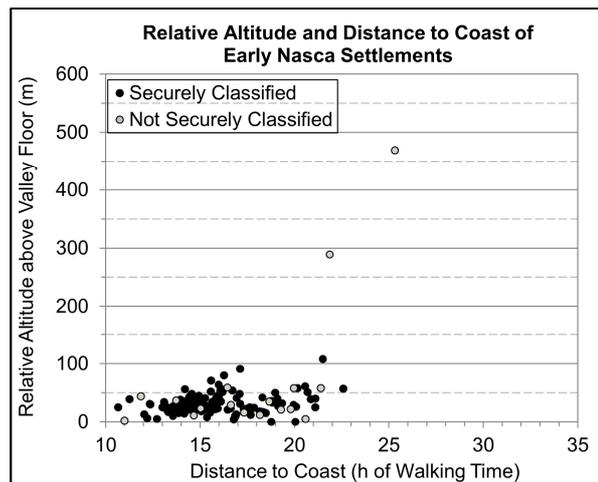


Figure 85: Relative altitude above the valley floors and walking time distance to the coast for Early Nasca settlements. Graphic: VS.

¹¹⁴ It has to be kept in mind, however, that not all of the villages showing up on Map 21 will have existed simultaneously.

Molinos). At S-32 (Llipata), the uppermost platforms were separated from the lower sectors by an *adobe* wall crossing the whole spur (Browne n.d.).

In both cases, the intention seems to have been to restrict access to certain structures, which indicates social differentiation inside the same settlement rather than concerns for attacks from outsiders. If the regions adjacent to the study area were either largely uninhabited (*cabezadas* and *puna*) or incorporated into the same polity (neighboring valleys), there were no potential enemies close-by. Internal conflicts would have been mediated or suppressed by the central authority.

The settlement hierarchy also supports a scenario of political unification. While the 53.8% share in total area of common settlements is about average in a diachronic comparison (Figure 27), the relation of local and simple centers is interesting. While simple centers accounted for only 16.2%, the three large local centers along the left margin of the great floodplain combined covered at least some 50 ha and made up for almost a third (29.9%) of the overall settlement area (Figure 89). The proximity of these three settlements suggests that they functioned together rather than heading distinct or even competing polities. If the whole complex served as the seat of power for the whole NGD, this would have required facilities for administration, representation, and communal rituals as well as domestic sectors for the ruling elites and commoners engaged in non-agrarian activities (servants, carriers, craftsmen, construction workers, etc.). Unfortunately, the destruction of most of the sectors that may have been dedicated to such specific activities inhibits distinguishing any functional differentiation within the sites. Only the large platform-geoglyph complexes can be designated with some confidence as sites for communal gatherings, most likely religious ceremonies. Simple centers were comparatively fewer in number and made up for a lesser part of the total area (16%) than in all other phases between Middle Paracas and Late Nasca. They are spatially distributed more or less evenly and perhaps each controlled a certain section of the cultivated valley floor. These simple centers were probably not independent but subordinate to S-32, S-33, and S-34.

6.5.2.4. Major Inter-Phase Developments

If a unified Early Nasca polity with its capital at Cahuachi indeed existed then it was relatively short-lived. Cahuachi itself was largely abandoned before the end of the phase and the same seems to have happened to the related provincial centers. In the study area, only S-35 at PAP-77/78 (El Arenal) maintained its status in the succeeding phase while other local and simple centers were either completely abandoned or reduced in size and status. From the relative distance charts (Figures 83 and 86) it can be deduced that settlements tended to spread out and move towards the middle valleys. While at phase start, the densest cluster was located 13-16 walking hours from the coast, at phase end the pattern is more dispersed. No change is observable concerning the preference for inhabiting non-defensive valley margin sites below 50 m above the valley floor.

There is relatively little difference in the general settlement pattern between the beginning and end of the phase (compare Map 20 to Map 22). Only 33.1% of the settled area at the IN-EN transition had been dislocated when the Middle Nasca phase began, which is the lowest value of all phases. Since subsistence strategies did not change and people relied almost exclusively on irrigation agriculture throughout the phase, there was little reason to move. However, another 33.7% of the total settlement area occupied at phase start was abandoned during the phase without replacement, suggesting that population levels shrank by about 0.2% per year if a steady process is assumed (Figure 89). This assumption, however, is not realistic. The great centers along the left margin of the great floodplain, where arguably not only power but also population was concentrated, were established at some point during Early Nasca and then largely abandoned before the beginning of Middle Nasca. Their combined area of 50 ha exceeds the total area occupied at phase end (48 ha). What seems to have happened is, first, a rise in population levels towards the middle of the Early Nasca phase and then a

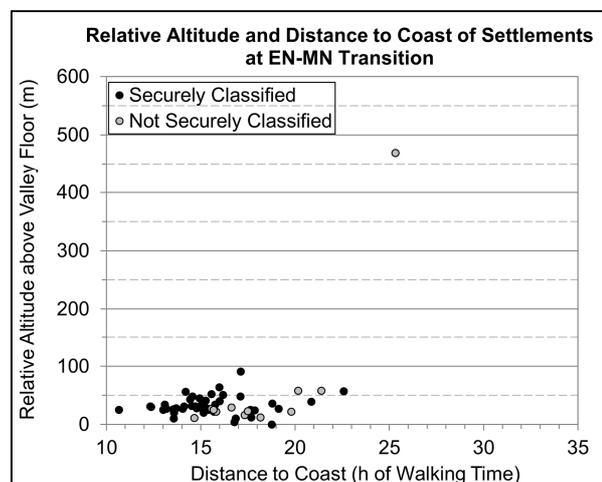


Figure 86: Relative altitude above the valley floors and walking time to the coast for settlements at the EN-MN transition. Graphic: VS.

more or less rapid decline, directly related to the abandonment of the major local seats of power. The political system established during Early Nasca seems to have experienced a severe crisis leading to the breakdown of power structures and perhaps also to a significantly reduced productivity of the centrally organized economic system. This crisis seems to meet Joseph Tainter's criteria for a collapse (see Chapter 4.1).

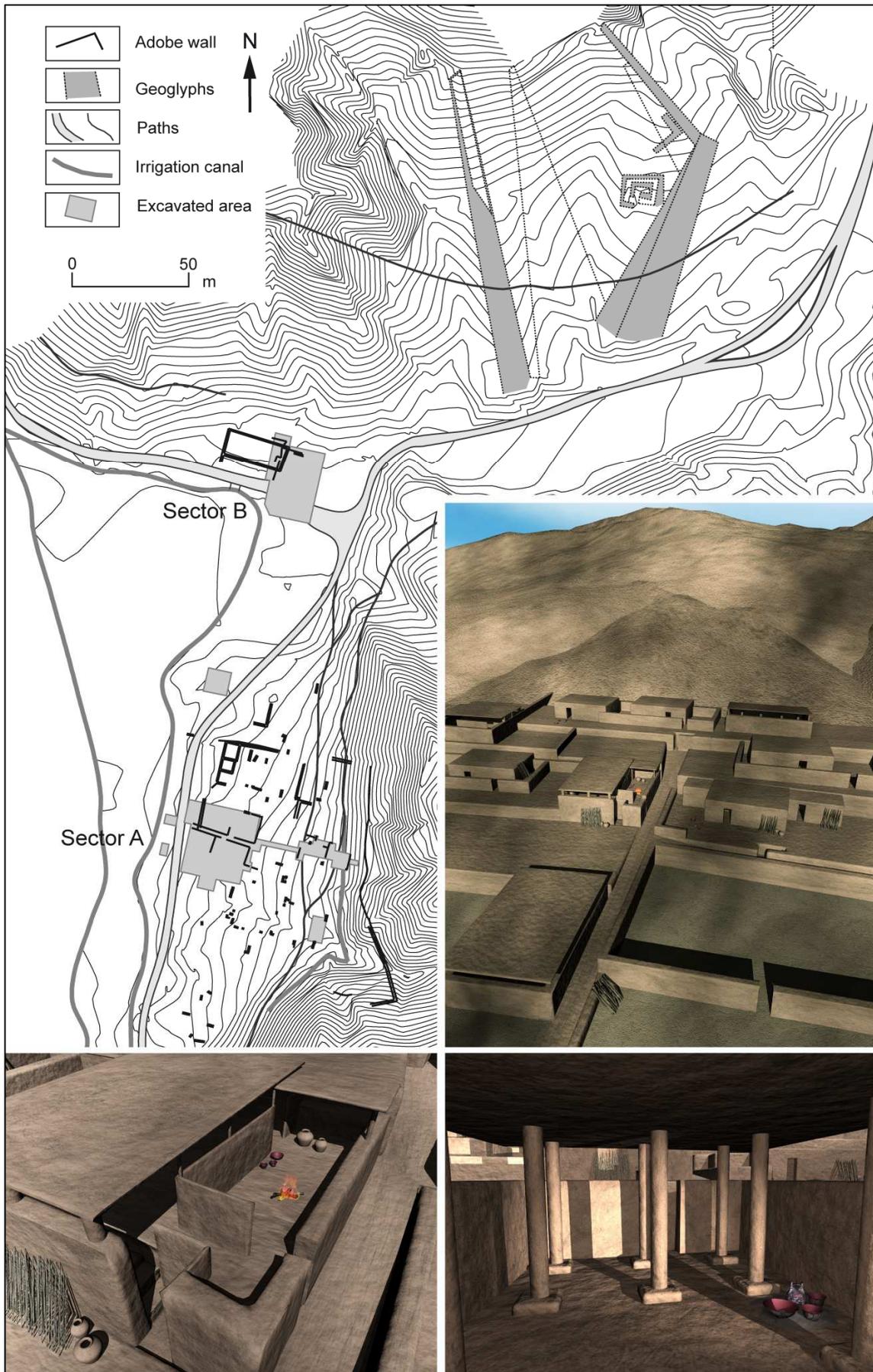


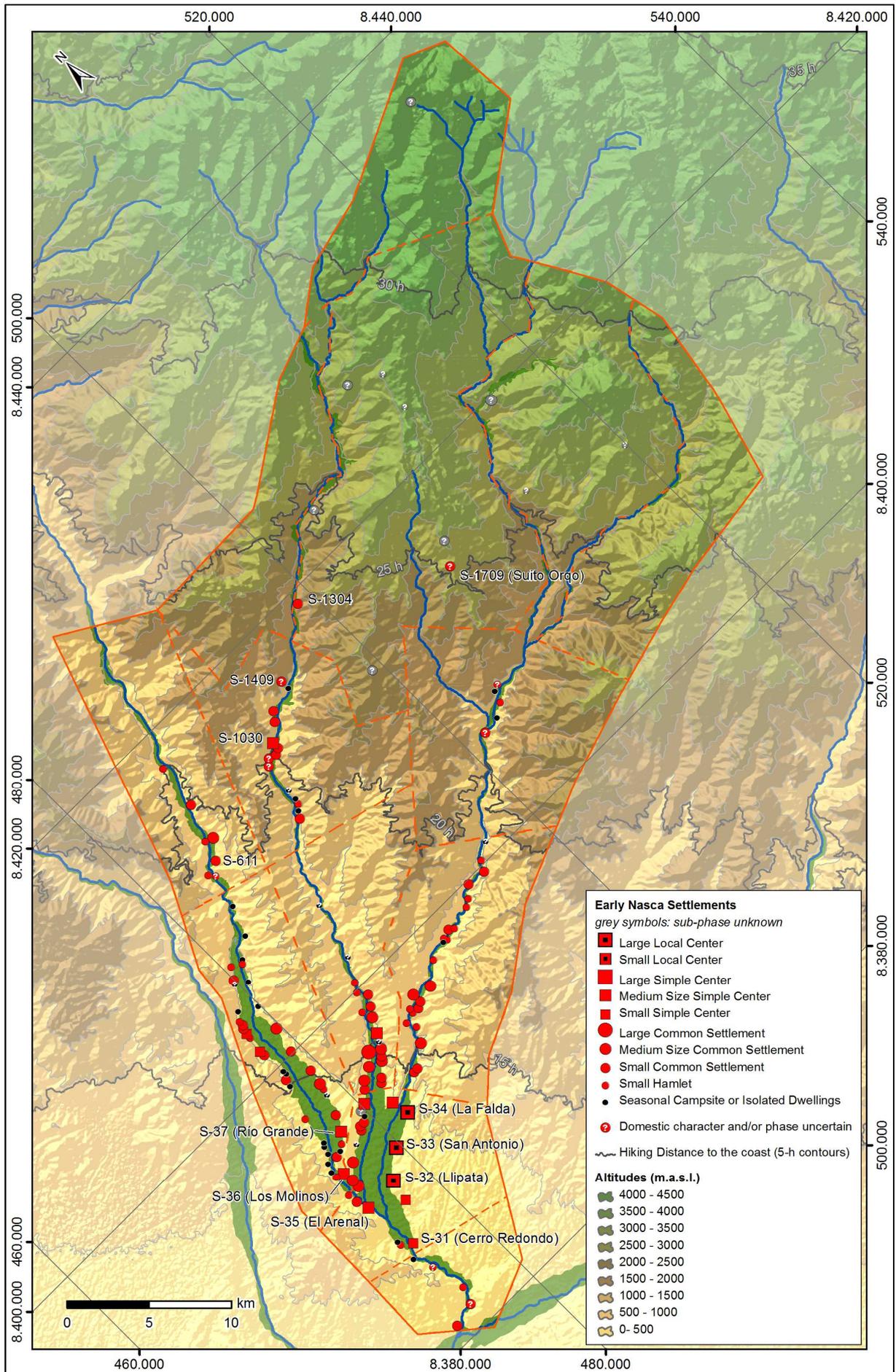
Figure 87: Survey plan of PAP-93 (Los Molinos). The inset graphics show a digital reconstruction of the central and principal sector A, based on the results of extended excavations. Survey plan: Palpa Project, slightly modified by VS. Inset graphics: Jens Tomkowitz.



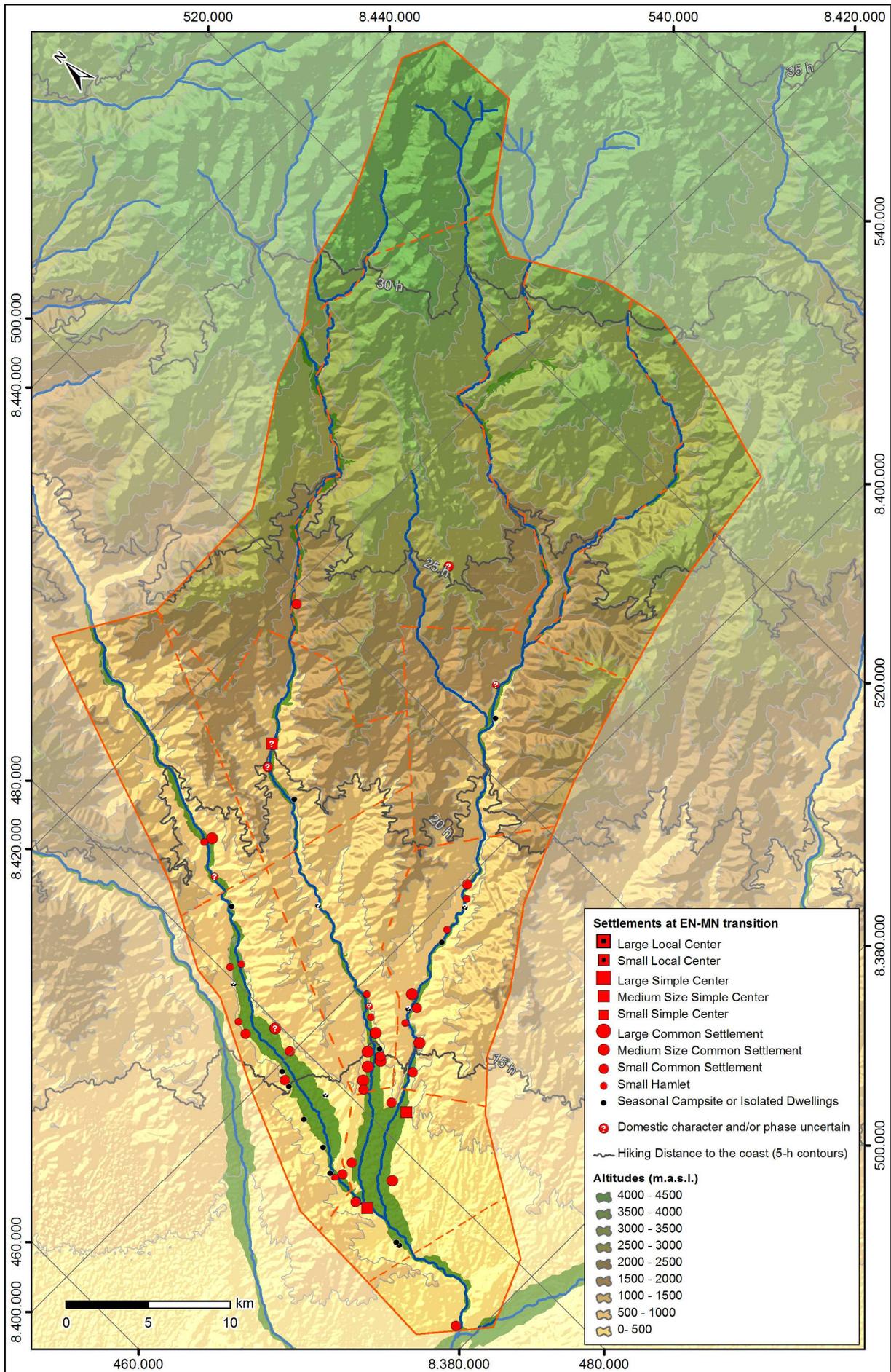
Figure 88: The central section of the great EN center S-32 (Llipata), comprising in particular the sites PAP-346 and 352, on the SAN aerial photo 524-561 from 1944. Note the typical platform/stairway with adjacent straight lines at PAP-352. Despite the obvious importance of the sites in this area, they have been subject to mindless destruction during the last decades, especially by the amplification of the modern village of Llipata into the quebradas. The ancient structures there were simply razed with heavy machinery. There is still no kind of protection. Photo: Servicio Aerofotográfico Nacional.

Early Nasca Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	Phase length
Likely date: 80 CE		300 CE	Likely length: 220 years
Earliest possible date: 40 CE		270 CE	Shortest possible length: 160 years
Latest possible date: 110 CE		340 CE	Longest possible length: 300 years
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
Total:	135 (118)	166.98 ha (160.52 ha)	1.24 ha (1.36 ha)
<i>b-type settlements (minimum extent):</i>	32 (28)	22.25 ha (20.74 ha)	0.74 ha (0.74 ha)
<i>At phase start (types a + bS):</i>	66 (56)	72.44 ha (66.09 ha)	1.10 ha (1.18 ha)
<i>At phase end (types bE + c):</i>	59 (52)	48.04 ha (41.16 ha)	0.81 ha (0.79 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	42 (38)	53.67 ha (47.33 ha)	1.28 ha (1.25 ha)
Growth and dislocation			
Area net growth: -24.40 ha (-24.93 ha)		-33.7 % (-37.7 %)	
Dislocated area: 23.97 ha (18.62 ha)		33.1 % (28.2 %)	
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
Area growth per year:	-0.19 % (-0.22 %)	-0.26 % (-0.30 %)	-0.14 % (-0.16 %)
Population Index:	0.76 (0.73)	1.04 (1)	0.56 (0.54)
Status classes			
Number of settlements		Settlement area	
<i>Non-permanent settlements:</i>	0 (0) 0.0 % (0.0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
<i>Common settlements:</i>	121 (104) 89.6 % (88.1 %)	89.90 ha (83.44 ha) 53.8 % (52 %)	
<i>Simple centers:</i>	11 (11) 8.1 % (9.3 %)	27.12 ha (27.12 ha) 16.2 % (16.9 %)	
<i>Local centers:</i>	3 (3) 2.2 % (2.5 %)	49.95 ha (49.95 ha) 29.9 % (31.1 %)	
<i>Administrative posts:</i>	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
<i>Administrative centers:</i>	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
Population size classes			
Number of settlements		Settlement area	
<i>Isolated dwellings:</i>	32 (24) 23.7 % (20.3 %)	4.25 ha (3.33 ha) 2.5 % 2.1 %	
<i>Small hamlets:</i>	33 (30) 24.4 % (25.4 %)	11.69 ha (10.45 ha) 7.0 % 6.5 %	
<i>Small settlements:</i>	45 (39) 33.3 % (33.1 %)	36.12 ha (31.82 ha) 21.6 % 19.8 %	
<i>Major settlements:</i>	21 (21) 15.6 % (17.8 %)	59.43 ha (59.43 ha) 35.6 % 37.0 %	
<i>Population centers:</i>	4 (4) 3.0 % (3.4 %)	55.50 ha (55.50 ha) 33.2 % 34.6 %	

Figure 89: Basic data of Early Nasca settlements. Graphic: VS.



Map 21: All settlements of the Early Nasca phase. Map: VS.



Map 22: Settlements probably occupied simultaneously at the transition from the Early to the Middle Nasca phase. Map: VS.

6.5.3 The Middle Nasca Phase (MN)

The Middle Nasca phase began around 300 CE and lasted for some 140 years. The 17 ¹⁴C samples processed were taken at five different sites, all of which are located at the foothills (Unkel et al. 2012:2302). Although the dating of the start and the end of the phase is reasonably accurate, in relation to the comparatively short phase length the margin of error is still significant and ranges between 70-200 years. This issue may lead to serious distortions of all statistical indicators related to phase length.

Despite general cultural continuity there were also some new but gradual developments in the foothills during the Middle Nasca phase, namely in iconography. In some centers, orthogonal complexes including large platforms or plazas and adjacent smaller rooms were constructed of stone. On the political level, a clear break seems to have occurred. Immediately after Cahuachi and other Early Nasca centers, including Llipata (S-32), San Antonio (S-33), La Falda (S-34), and Los Molinos (S-36), were widely abandoned, new local seats of power emerged. There is no evidence for a centralized polity. Instead, as their extraordinary rich tombs suggest, local leaders became wealthy and powerful (Isla Cuadrado & Reindel 2006). The *cabezadas* saw a massive, but short-lived resettlement. However, the completely different architecture and settlement layout raises questions about cultural and perhaps also ethnic differences between foothill and *cabezadas* dwellers.

The total number of settlements rose again to 150, but the average size of 1.15 ha stayed roughly the same as in the preceding phase. The total settlement area amounted to about 173 ha. The short phase duration of only 140 years increases the probability that many, if not most, of these villages were actually occupied simultaneously at some point. There was little change in the share of the total area of isolated dwellings (2.9%), small hamlets (4.6%), and small settlements (21.9%), but interestingly the percentage of major settlements raised significantly, from 35.6% to 56.3%, while that of population centers dropped drastically from 33.2% to 14.3% (Figure 96). This is mainly the effect of the abandonment of the large EN settlements along the left margin of the great floodplain while many major but much smaller villages were newly established.

6.5.3.1. Settlement Layout and Construction Techniques

Simple Middle Nasca settlements at the foothills show the same characteristics as in earlier phases. At the lower sections of moderate slopes at the valley margins, domestic refuse can be found on the remains of irregular terraces, which probably once supported light *quincha* huts. In the settlements classified as centers, there is a certain tendency to construct large rectangular plazas at the lower sectors of a site and to surround them with smaller, probably roofed, rectangular rooms. Such obviously carefully planned complexes of rectangular structures are observable at several sites, though only few have been excavated. They probably served some kind of administrative or representative purposes. They may also have been elite residences, but they were certainly not ordinary homes. Additionally, platforms connected to geoglyphs, as they are known from a number of Early Nasca centers, can also be observed in some Middle Nasca settlements, e.g., in S-41 at PAP-79 (La Muña), S-44 at PAP-254 (Santa Rosa), or S-47 at PAP-302 (Viscas).

In the lower parts of the study area including the great floodplain and the lowermost part of the middle Río Grande valley, *adobe* continued to be the preferred building material for high status constructions while further upstream, stone structures became common in all three valleys. In S-47 at PAP-302 (Viscas), both materials were used, but stone dominated and at PAP-78 (El Arenal) some walls belonging to S-67 consisted of a mix of stones and *adobes* (Figure 90a, Reindel & Isla Cuadrado 1998). The *adobes* used had a greater height than those that were common during the Early Nasca phase and they had a circular or slightly oval base. The height-to-width ratio was roughly 3:1. Backing several lumps of clay one upon the other to form a single brick was a common technique (Figure 90c). At PAP-83 (La Muña Norte), a test pit dug into a platform belonging to S-42 revealed further details of the construction technique (Tomasto Cagigao et al. 2009): The space between the *adobe* retaining walls was filled with several alternating layers of loose earth and maize straw which was partly bound together with cords. Perhaps this design was especially shock-absorbent and therefore less vulnerable to earthquakes. Below the fill, there was a level floor of compacted clay, suggesting that the walls may originally have formed a room that was later filled in to serve as a terrace.

The most extensive excavations at any site with a domestic MN occupation took place at PAP-79 (La Muña). Though the work concentrated on the great elite tombs of the site's funeral sector, several

residential, administrative, and ritual structures were also studied (Reindel & Isla Cuadrado 2001, Figure 95). All structures were related to ceramic sherds of the Nasca 5 style and therefore date to Middle Nasca. This is in agreement with a number of ^{14}C -dates from the site. Excavations at a platform north of the tombs revealed two adjacent large platforms (13x13 m) with *adobe* retaining walls and remains of *huarango* posts on the inside that likely once supported a roof. The construction was surrounded by light *quincha* structures, which were clearly related to domestic activities. Another terrace at the south of the site was originally designed as an open platform but was later used as a base for *quincha* huts. To the northwest (sector C), a stairway-platform/geoglyph complex, as it is already known from several EN centers, is still visible. Excavations here unearthed the surrounding *adobe* walls and the entrance to the lowermost plaza, but no superstructures were found. However, a line of pits may actually represent postholes which would suggest a roof construction. The poles might have been removed and reused when the settlement was abandoned.

Test pits were also dug at PAP-78 (El Arenal) and PAP-83 (La Muña Norte), which are two other sites where large platforms existed (Figure 90a/b). These belonged to S-67 and S-42, respectively which may have formed a functional unit together with close-by S-41 (La Muña) and perhaps also S-43 at PAP-87 (Loma Larga).

As mentioned above, complexes of rectangular structures existed at most centers but in many cases they were razed in recent decades or heavily damaged by looting. At PAP-15, a small 2x2 m test pit revealed the double-face stone base of one of the rectangular units belonging to S-50 (Reindel & Isla Cuadrado 1998:61-66) but the complex has been devastated so thoroughly by looters that it is now hardly possible to recognize the adjacent unexcavated structures. S-45 at PAP-165 at the left margin of the upper Río Grande valley shares a similar fate. S-44 at PAP-254 (Santa Rosa) and S-568 at PAP-196 (Parasmamarca) were already overbuilt in the Late Nasca phase.

A better preserved settlement, though still not excavated, is S-48 at PAP-625 (La Capilla). The site has already been mentioned several times because it contains significant occupations from previous phases as well. Without excavation, it is impossible to date the rectangular rooms and plazas of sectors A and B, but the good preservation and the fact that they have not been overbuilt suggest that they were erected during the latest occupation which corresponds to S-48 (Figure 66). This is also deducible from their similarity to complexes observed at other MN centers.

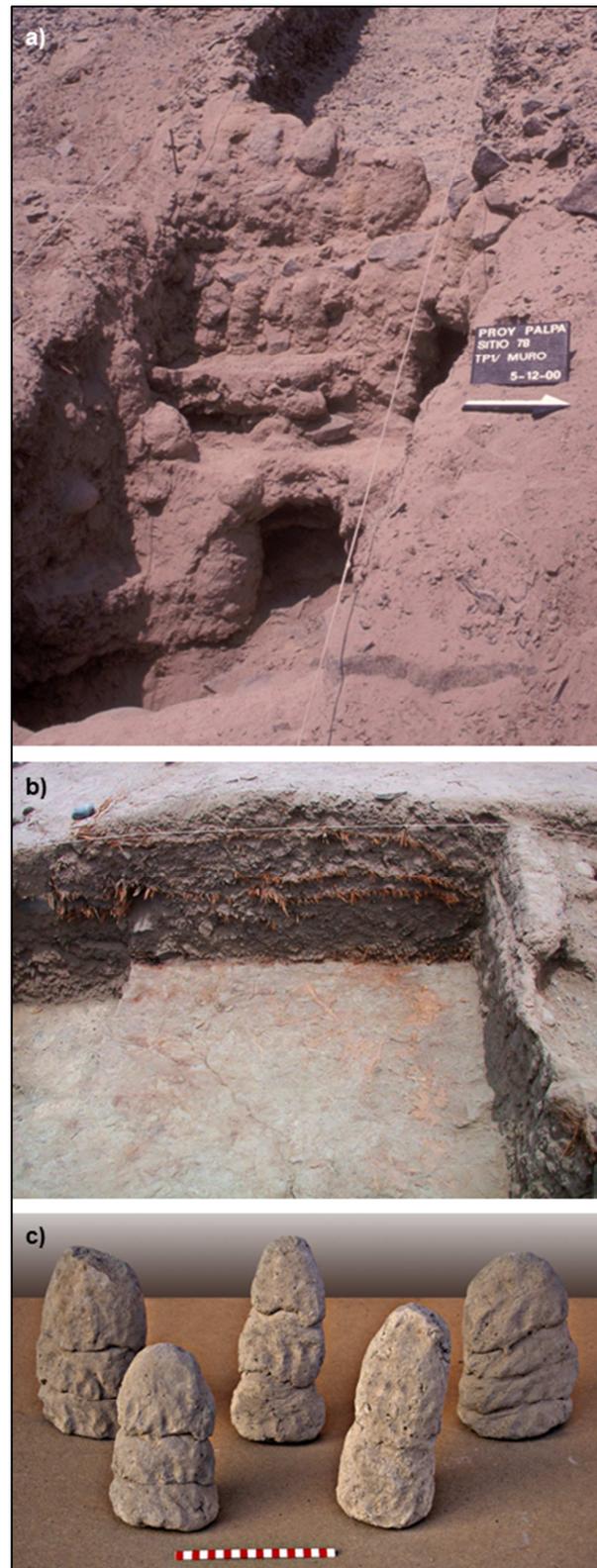


Figure 90: Details of Middle Nasca building techniques employed in foothill settlements: a) Unusual combination of stone and adobe in a terrace retaining wall belonging to S-37 at PAP-78 (El Arenal), b) Terrace fill of alternating layers of clay and maize straw at PAP-83 (La Muña Norte). The retaining wall (right) is built of adobes. c) Adobes from PAP-79 (La Muña) made of several lumps of clay backed one upon the other. All photos: Palpa Project.

One of the presumably most important settlements was S-47 at PAP-302 (Viscas). Most of what existed there is only known from old aerial photos since the site was razed with heavy machinery in the 1950s. Nevertheless, the SAN photo 524-806 from 1944 clearly reveals an apparently carefully planned large complex of rectangular structures and plazas measuring up to 30x50 m (Figure 91). Scale and layout of these structures suggest they had a special function probably connected to administrative, representative, and ritual activities. Some may also have housed members of the ruling elite. The cleaning of a small part of a profile produced by a bulldozer revealed some domestic refuse and sherds of the Nasca 5 style (Reindel et al. 2002). To the northwest, another combination of platforms and geoglyphs can be observed. S-47 also comprised simple dwelling sectors to the south-east of PAP-302 (not shown on the photo).



Figure 91: PAP-302 (Viscas) in 1944 on the SAN aerial photo 524-806 and today (upper right). Most of the rectangular plazas and structures of sectors A and H belonging to S-47 had been razed to the ground in the 1950s. The traces of the bulldozer are still visible today. Nevertheless, scale and layout of the structures suggest they had a special function probably connected to administrative, representative and ritual activities. Some may also have served as elite residences. The direct connection of the large platforms of sector A with the geoglyphs of sector D repeats a common pattern already known from Early Nasca centers. Photo: Servicio Aerofotográfico Nacional. Inlay photo: VS.

S-47 may have been related to S-46 at PAP-316, which was another center only about 2 km further downstream. It was only slightly smaller than S-47 but had a less extended sector with apparently formal architecture. There as well, remains of large rectangular enclosures built of round pebble stones and showing internal subdivisions are still visible. On a small hill forming part of the sector 314 A, traces of *adobe* walls associated with domestic refuse can also be observed. Though this area had been reused as a cemetery and therefore was subject to heavy looting, the remaining surface evidence suggests that an elite residential sector may have existed here.

In the upper valleys, only two settlements, S-1028 at PAP-576 and S-1229 at PAP-586/587, could perhaps classify as centers, although neither seems to have been especially important, judging from the sparse evidence of special architecture. There are some large platforms with internal subdivisions at PAP-587, which might also originate from Late Paracas times (S-1227). Size and layout, however, are more typical for Middle Nasca and some sherds of this phase are present on the surface. Without excavations, the date of construction cannot be determined.

During the Middle Nasca phase, the *cabezadas* were resettled, but the villages showed a structure and layout markedly different from those at the foothills. Most of the bigger settlements were established on well-defensible hilltops, often on top of the ruins of an earlier Paracas village. The houses of double-face stonewalls were circular in shape and built on construction terraces arranged more or less

concentrically around the hilltop. In addition to their naturally defensive locations, S-150 at PAP-808 (Lindero) and S-297 at PAP-960 (Cerro Tarapata) protected by walls and ditches, but since both sites were also occupied during the LIP, it is doubtful if these features date to MN.

There are differences in the average size and building quality of common houses between settlements but besides some larger plazas very little non-domestic high-status architecture is present. Common MN *cabezadas* dwellings were excavated at several sites, namely at PAP-808 (Lindero, Figure 92), PAP-814 (Huayuncalla), and PAP-873 (Suito Orqo).

Unlike the situation in Paracas settlements, houses in Middle Nasca *cabezadas* villages were almost exclusively built with double-face stonewalls with interior fill. This may represent an adaption to colder conditions as the thick walls and the earth-and-gravel fill provided good insulation. This hypothesis would have to be tested against the future results of ongoing temperature-related research on paleo-climate in the study area.



Figure 92: The excavated remains of a Middle Nasca round house with double-face stonewalls belonging to S-151 at PAP-808 (Lindero). A large quern with its handstone - a typical feature in domestic contexts - lay in situ inside the structure. Photo: Palpa Project.

6.5.3.2. Settlement Location and Subsistence

The distribution pattern of Middle Nasca settlements is similar to that of the Late Paracas phase and many sites, particularly in the highlands, show domestic occupations of both phases. The inhabited area ranged from 10-30 hours in terms of walking time to the coast (Figure 93). Interestingly, settlement density decreased around the great floodplain where the most extended areas suitable for irrigation agriculture were available. Instead, the entries to the Middle valleys seem to have been preferred for dwelling (Map 23).

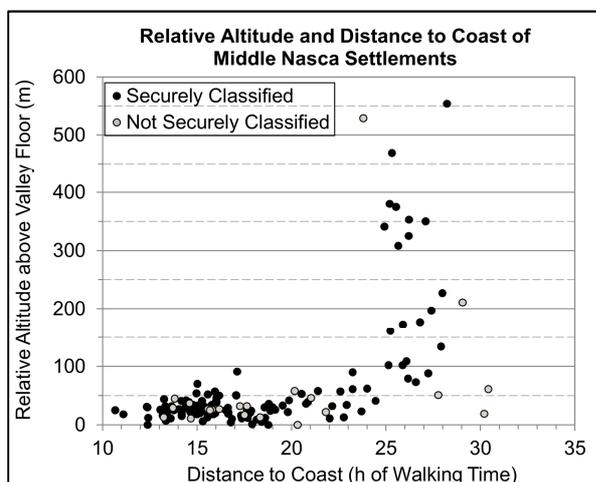


Figure 93: Relative altitude above the valley floors and walking time distance to the coast for Middle Nasca settlements. Graphic: VS.

The resources of the highlands must have become attractive again but it is difficult to assess to whom. Did the same people occupying the foothills also resettle the *cabezadas*? Although Nasca 5 ceramics occur in the highlands, the differences in house shapes and construction techniques would argue against this. Since no Nasca burials are known so far from the highlands, it is not possible to compare burial customs. This point will be discussed in detail in Chapter 7.6. Several smaller settlements include pens but these are few in number and of modest size. Furthermore, in many cases it is uncertain when they were originally constructed. As in earlier phases, herding was surely practiced but on a minor scale as a complementing subsistence activity rather than a principal one. *Cabezadas* dwellers will have been engaged predominantly in rain-fed terrace farming.

6.5.3.3. Hierarchy and Defensive Measures

There is little reason to postulate an increase in conflict during Middle Nasca times. Defensive walls are either absent or cannot clearly be attributed to a Middle Nasca occupation. At the foothills, most villages lay close to the valley floors and were easily accessible while the location of many *cabezadas* settlements high above the valley floor could also have been motivated by factors like good view of the

surrounding fields and pens, and direct visual connection to neighbors (Figure 93). Most settlements, making up 59.8% of the total settlement area, can be classified as common. This is a slight increase compared to the preceding phase. The percentage of area occupied by simple centers, in turn, almost doubled to 30.5% while that of local centers dropped from 29.9% down to 9.7 % (Figure 96). This may be seen as an indicator of a less pronounced settlement hierarchy.

No outstanding regional center comparable to Cahuachi which could have functioned as the capital of a multi-valley polity existed during Middle Nasca. In the study area, the settlement pattern suggests a split in political power after the abandonment of the large local centers at the left margin of the great floodplain. At the foothills, the power vacuum seems to have been filled by local elites who established their principal seats of power at S-42 (La Muña) and S-47 (Viscas) or S-48 (La Capilla). The latter two settlements are located relatively close to each other and it is not likely that they were independent or even competing. They may have either belonged to the same polity or have been occupied successively (though both were abandoned before the end of the phase). Judging from the settlement distribution, S-41 may have controlled the middle Río Grande valley and the section immediately adjacent upstream and downstream. S-47 or S-48 (or the two together) could have dominated the middle Palpa and Viscas valleys, especially the lower sections, and the adjacent parts of the great floodplain. There were several simple centers, but at least those in the middle valleys and farther downstream likely had a subordinate status.

The situation was different at the *cabezadas* where no settlement showed indications of a local center. There may have existed loose alliances between ruling elites residing in the simple centers but the lack of formal architecture – which could hint to a centralized administration – does not suggest a unified highland polity. There are nevertheless no clear indications of violent conflict either. Since the area was almost completely uninhabited in the preceding phase, a struggle for cultivable land is unlikely. Other conflicts, if they occurred, may have been easier to settle while there was still sufficient space for farming and dwelling.

6.5.3.4. Major Inter-Phase Developments

The Middle Nasca phase seems to have been a time of rapid change. In just about 140 years the settlement pattern underwent two drastic developments: drastic shifts in population levels and a dislocation of settlement on a considerable scale.

When comparing start and end (Maps 22 and 24, and Figures 86 and 94), the impression is one of a smooth process of gradual decrease in overall settlement area, by -0.21% per year and -26% in total, and of a displacement of some villages from the foothills to the highlands. This impression is quite misleading as 69 out of 150 villages had no direct preceding or succeeding occupation (Figure 96). This means that they must have been established after the EN-NM transition and abandoned perhaps less than a hundred years later, before the start of the Late Nasca phase. Many of these were located in the *cabezadas*. They do not show up on the transition maps nor do they influence the statistical values calculated for the phase start and the phase end.

The shortness of the Middle Nasca phase increases the probability that most of these *d*-type settlements were in use simultaneously for some decades at some point during the phase, together with all of the *b*-type and probably many of the *a*- and *c*-type villages.¹¹⁵ This fact suggests a dramatic increase in population levels, which would go hand in hand with a massive short-term resettlement of the *cabezadas*. Only a major immigration from outside the study area can explain such a rapid pace of growth. The majority

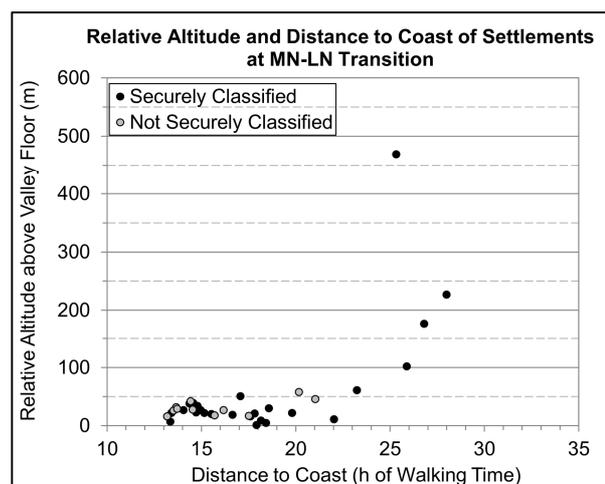


Figure 94: Relative altitude above the valley floors and walking time distance to the coast for settlements at the MN-LN transition. Graphic: VS.

¹¹⁵ See Chapter 5.3.2. Only in very few cases is the exact occupation span of individual settlements known. The shorter the phase, the higher the probability of temporal overlapping of occupation spans.

of the highland settlers may have come from adjacent regions with similar conditions but probably not from the foothills. Wherever they emerged, they brought with them their cultural particularities, especially with respect to architecture and settlement layout. Middle Nasca highland dwellings show more similarities to those in the same area from earlier Late Paracas and later Ica times than to their contemporary counterparts at the foothills.

The fact that so many villages were left before the end of Middle Nasca is evidence for a population decline during the phase's last decades, a drop even more pronounced than the increase shortly before. The foothills were affected, too, as most settlements in the Viscas valley and many in the Palpa valley were abandoned before phase end, including the large centers S-47 (Viscas) and S-48 (La Capilla). Strange and still unexplained is the fact that at the beginning of the Late Nasca phase almost all villages in the Palpa valley lay at the right margin while the left margin was largely abandoned.

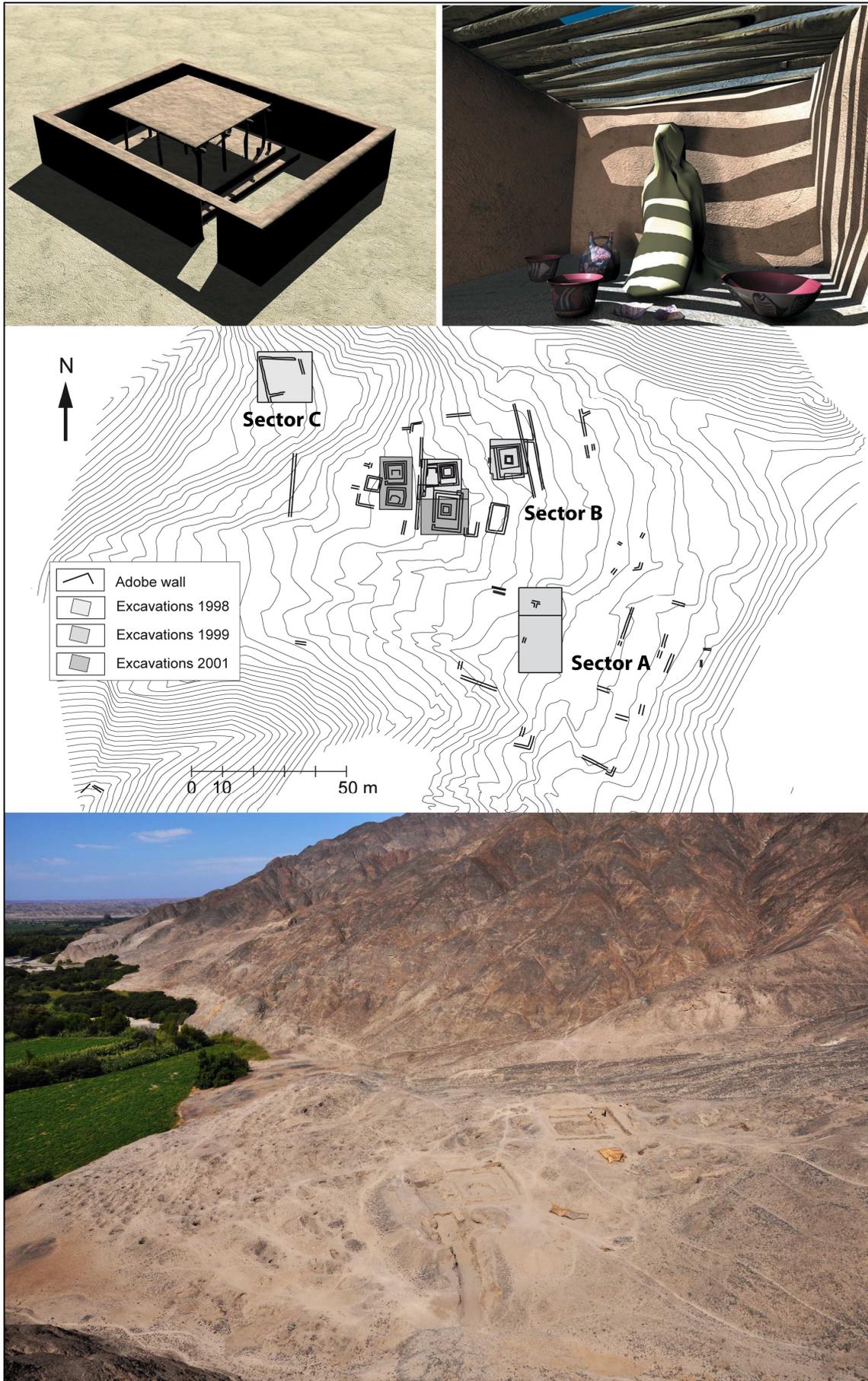
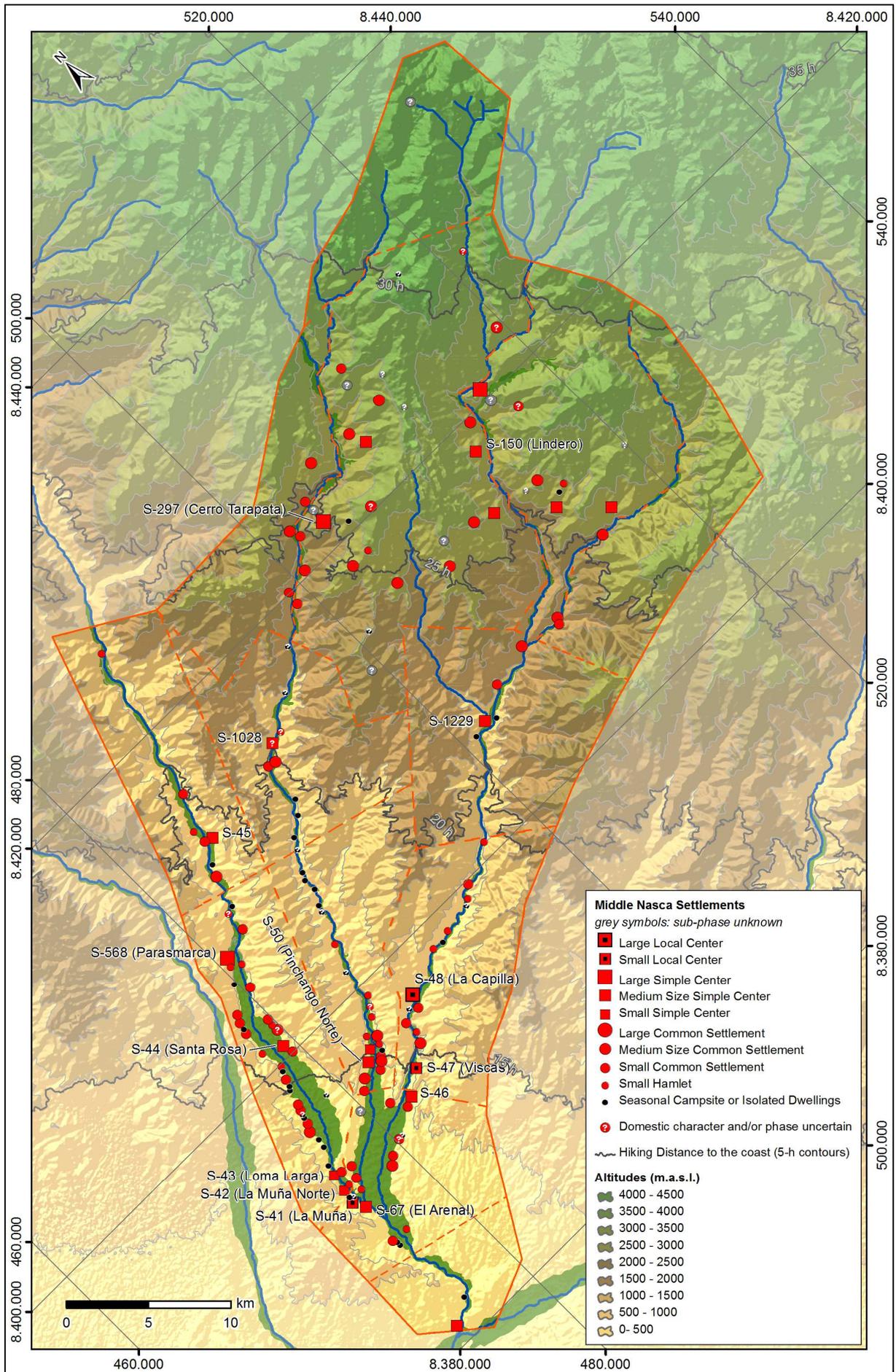


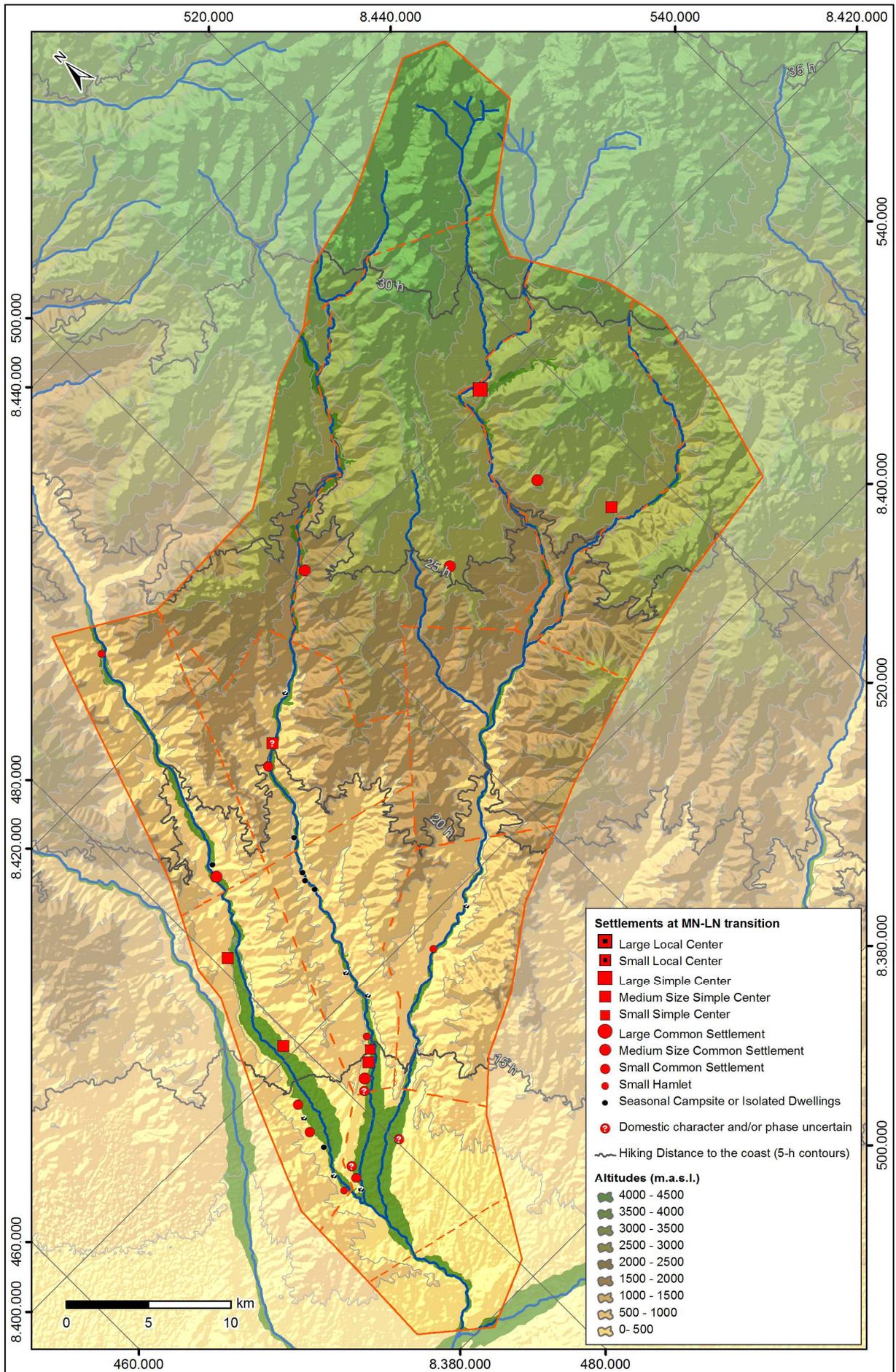
Figure 95: Survey plan of PAP-79 (La Muña). Top: digital reconstruction of the surface structure and the chamber of tomb 3 in sector B. Bottom: panoramic view of sectors A and B. Survey plan: Palpa Project. Graphics at top: Jens Tomkowitz. Photo at bottom: Heike Otten.

Middle Nasca Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
Likely date: 300 CE		440 CE	
Earliest possible date: 270 CE		410 CE	
Latest possible date: 340 CE		470 CE	
			Phase length
			Likely length: 140 years
			Shortest possible length: 70 years
			Longest possible length: 200 years
Settlement number and area			
	Number	Area	Avg area
Total:	150 (127)	173.22 ha (158.47 ha)	1.15 ha (1.25 ha)
<i>b</i> -type settlements (minimum extent):	13 (8)	8.01 ha (5.05 ha)	0.63 ha (0.63 ha)
At phase start (types a + bS):	58 (46)	48.04 ha (39.99 ha)	0.83 ha (0.87 ha)
At phase end (types bE + c):	36 (31)	35.56 ha (30.41 ha)	0.99 ha (0.98 ha)
Established after phase start and abandoned before phase end (type d):	69 (58)	89.08 ha (79.36 ha)	1.29 ha (1.37 ha)
Growth and dislocation			
Area net growth:		-12.48 ha (-9.58 ha)	-26.0 % (-23.9 %)
Dislocated area:		26.77 ha (24.57 ha)	55.7 % (61.5 %)
		Likely phase length	Shortest phase length
Area growth per year:		-0.21 % (-0.20 %)	-0.43 % (-0.39 %)
Population Index:		1.24 (1.13)	2.47 (2.26)
		Longest phase length	-0.15 % (-0.14 %)
Status classes			
Number of settlements		Settlement area	
Non-permanent settlements:	1 (1)	0.7 % (0.8 %)	0.03 ha (0.03 ha)
Common settlements:	127 (105)	84.7 % (82.7 %)	103.63 ha (90.63 ha)
Simple centers:	19 (18)	12.7 % (14.2 %)	52.75 ha (51.01 ha)
Local centers:	3 (3)	2.0 % (2.4 %)	16.80 ha (16.80 ha)
Administrative posts:	0 (0)	0.0 % (0 %)	0.00 ha (0.00 ha)
Administrative centers:	0 (0)	0.0 % (0 %)	0.00 ha (0.00 ha)
Population size classes			
Number of settlements		Settlement area	
Isolated dwellings:	41 (28)	27.3 % (22.0 %)	4.97 ha (3.57 ha)
Small hamlets:	26 (22)	17.3 % (17.3 %)	8.05 ha (6.85 ha)
Small settlements:	39 (37)	26.0 % (29.1 %)	37.92 ha (35.16 ha)
Major settlements:	40 (36)	26.7 % (28.3 %)	97.51 ha (88.13 ha)
Population centers:	4 (4)	2.7 % (3.1 %)	24.77 ha (24.77 ha)

Figure 96: Basic data of Middle Nasca settlements. Graphic: VS.



Map 23: All settlements of the Middle Nasca phase. Map: VS.



Map 24: Settlements probably occupied simultaneously at the transition from the Middle to the Late Nasca phase. Map: VS.

6.5.4 The Late Nasca Phase (LN)

The Late Nasca phase began around 440 CE and lasted for some 200 years. The margins of error for the phase length of ± 50 years are comparatively low, but most ^{14}C samples were taken at a single site: PAP-196 (Parasmarca, Unkel et al. 2012:2302). A future incorporation of samples from Late Nasca contexts at other sites in the chronological model could lead to a slight shift of the phase boundaries or to wider margins of error.

The Late Nasca phase seems to have witnessed the slow fading of the Nasca culture in combination with a continuing population decline at the foothills and the weakening of local polities. Settlements shrank in number and apparently also in average size. The latter phenomenon contrasts Schreiber's observation that Late Nasca settlements in the SGD notably *increased* in size, though not in number (Schreiber & Lancho Rojas 2003:17:146-148). Only 69 villages with a mean size of 0.97 ha were registered in the study area (67 ha in total). The share of small hamlets (8.1%) and small settlements (26.7%) in the total settlement area increased to the expense of major settlements (48%) while the percentage of isolated dwellings (3.5%) and population centers (13.5%) stayed roughly the same (Figure 101). The local centers of the Middle Nasca phase were abandoned while some of the simpler ones, located at the transition between the middle Palpa valley and the great floodplain and in the middle Río Grande valley, increased their status and became the new seats of power.

This power dwindled towards the end of the phase while foreign influences from the Ayacucho region became stronger, especially in iconography (Proulx 1994). On the other hand, many Late Nasca centers comprised complexes of orthogonal plazas and adjacent rooms as they were introduced already in Middle Nasca. These complexes may have influenced the development of the orthogonal cellular architecture present in many administrative sites attributed to the Wari culture (Canziani Amico 2009:313-346, Isbell 1991, McEwan & Williams 2012). Likewise, Late Nasca iconography strongly influenced early Wari ceramic styles (Knobloch 2005, Menzel 1964). Cultural influences between the Río Grande drainage and the Ayacucho region seem to have worked in both directions.

6.5.4.1. Settlement Layout and Construction Techniques

The Late Nasca Phase was not an innovative time in terms of architectural forms and settlement layout. At the foothills, the common settlements still consisted of stone terraces with *quincha* dwellings on top while the formal architecture in the centers continued to follow the pattern of agglutinated rectangular structures, generally large plazas, and smaller roofed rooms with double-face stonewalls. In most cases, these were erected on relatively flat or slightly inclined terrain. Building traditions originating in Initial and Early Nasca times, which had still continued in some Middle Nasca settlements, ceased completely. This holds true for the pattern of platforms located above the dwelling sectors and connected to geoglyphs as well as for the use of *adobe* as building material for important structures. The latter might be an effect of cultural influences from the highlands where stone was used more or less exclusively for constructions of any kind.

Excavations at PAP-196 (Parasmarca) in the upper part of the middle Río Grande valley revealed details of a complex of rectangular stone-built structures belonging to S-59 (Reindel 2009:455-456, Tomasto Cagigao et al. 2009). Here, a formal high status sector was separated from the surrounding simple dwellings by a massive perimeter wall. Inside of it, large terraced platforms constituted the bases for smaller rectangular structures connected by corridors (Figure 97). All walls were double-faced and built of field stone with an interior fill of clay and gravel. At least two major construction phases were observed there, but both contain sherds of the Nasca 7 style.

At PAP-16, which forms the core sector of S-68, no excavations have taken place so far. On the surface, however, the remains of another complex including a large (60x25 m) plaza and rectangular structures on two adjacent platforms are still visible. Due to severe damage caused by looting during the last decades, the perimeter walls of the complex are best visible in old SAN-photos from 1944.¹¹⁶ It is possible that the structures were already built in the Middle Nasca phase and formed part of S-49 but in this case they seem to have stayed in use. The architectural similarity to other Late Nasca centers, however, is an indication for a late erection or a modification and amplification.

¹¹⁶ The respective photos are 524-531, 524-532, and 524-557.

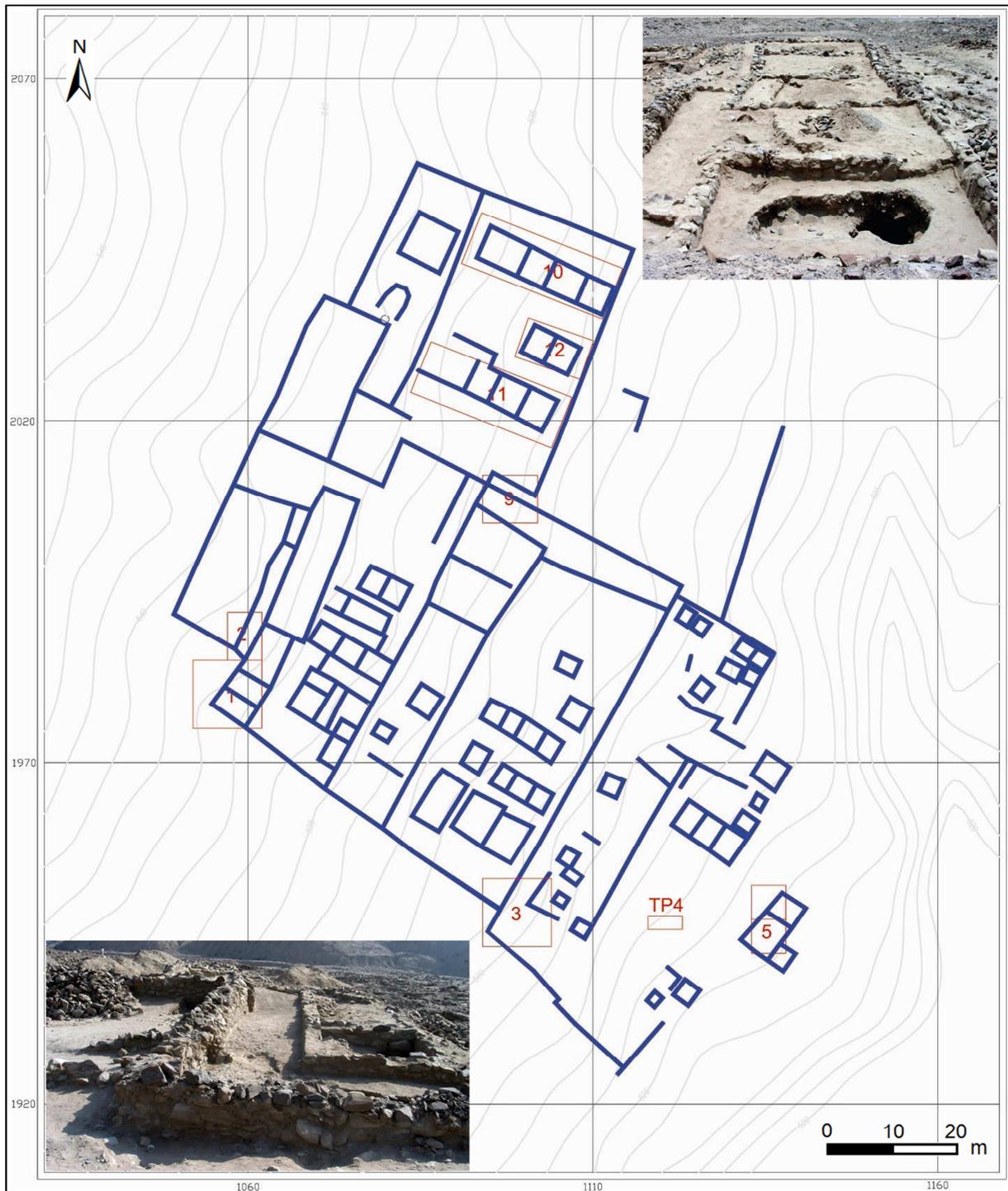


Figure 97: Survey plan of sector A of PAP-196 (Parasmarca). Inlay lower left: architectural detail of the walls exposed in units 1 and 2 and the area adjacent to the east. Inlay upper right: funeral structures excavated in unit 11. These tombs contained Nasca 8 (Loro) ceramics of the early Middle Horizon and hence slightly postdate the Late Nasca settlement. Plan and inlay photos: Palpa Project.

Similar complexes are also known from a number of further LN centers. Only about 5 km upstream from Parasmarca, S-61 at PAP-180 (Huaraco), though less extended, must also have been of particular importance (Reindel 2009:455-456, Tomasto Cagigao et al. 2009). Unfortunately, the site has partly been razed and severely looted. The basic layout of rectangular enclosures and rooms is nevertheless still recognizable on the surface. Test pits dug by the Palpa Project in 2006 revealed the same kind of walls and a similar layout pattern as observed at PAP-196. This sector, which apparently contained elite residences, was surrounded by simpler dwellings with thin stone and *quincha* walls. S-61 also includes PAP-169 directly opposite across the river, where a number of large terraced platforms with adjacent rectangular rooms can be observed (Figure 98). The largest plaza measures



Figure 98: Large platforms belonging to S-61 at PAP-169. The lower plaza measures about 16x60 m. The spur visible in the upper left corner of the picture belongs to PAP-180 whose LN occupation is also included in S-61. Photo: VS.

about 16x60 m. This complex may have been dedicated to administrative functions and communal gathering, complementing the residential sectors at PAP-180. More centers following the same architectural pattern existed in the lower sections of the study area, namely at PAP-16 (S-54), PAP-66 (S-53), and PAP-253/255 (Santa Rosa, S-57). In other cases, like S-58 at PAP-237/238 (Campanario), S-56 at PAP-4, and S-762 at PAP-25/30, the architectural pattern may also have been similar but the state of conservation and the uncertain phase association of superficially observable structures makes it difficult to get a realistic impression of the respective Late Nasca occupations. The difference in size suggests that S-58 may have been subordinate to S-57 on the opposite valley margin, while also forming a functional unit with it.

At the *cabezadas*, almost all LN settlements had already been established in the preceding phase and it is difficult if not impossible to distinguish between the two occupations without excavation. No noticeable change in settlement layout and building technique had taken place, which means that settlements continued to consist of round, double-walled stone houses built on terraces arranged more or less concentrically around a hilltop. No excavation in the *cabezadas* has so far concentrated on a Late Nasca settlement. Traces of occupations of this time, such as sherd clusters, activity zones, and compacted floors were documented at PAP-814 (S-8) and PAP-873 (S-216) but most of the excavated structures at these sites belong either to earlier or later phases.

6.5.4.2. Settlement Location and Subsistence

During Late Nasca, settlements at the *cabezadas* were few. This suggests some rain-fed farming and camelid herding on a significantly reduced scale compared to the height of the Middle Nasca phase. Settlement density at the foothills decreased in general, although the upper and middle sections of the Palpa valley were briefly resettled but, strangely, only the right margin (Map 25).

Diminishing resources or productivity could have motivated emigration. It is possible that a decrease in the amount or the reliability of annual precipitation caused a shortage of irrigation water. In this case it can be expected that people limited cultivation to the fields with the most reliable water supply, which are those in the upper and middle valleys and those close to springs. The abandonment of the last few settlements in the lower Río Grande valley and the lowermost part of the great floodplain would be in accordance with this scenario. The remaining villages were all located at more than 13 hours walking time distance from the coast (Figure 99).

6.5.4.3. Hierarchy and Defensive Measures

Although Late Nasca settlements were smaller on average than in previous phases, many of them seem to have had an elevated status. While less than half of the overall settlement area (49.2%) belonged to common settlements, the other half can be attributed to centers: 41.8% to simple centers and another 9.0% to local centers (Figure 101).

There is no obvious evidence for armed conflict. Defensive walls and sling stone deposits are absent. Furthermore, most villages were established close to the valley floors, except in the *cabezadas* where high elevation settlements do not necessarily indicate defensive considerations (Figure 99). Apparently, there was no armed struggle for land and water. People who could not be supported any more by local resources must have had the option to retreat to still relatively sparsely populated regions outside the study area.

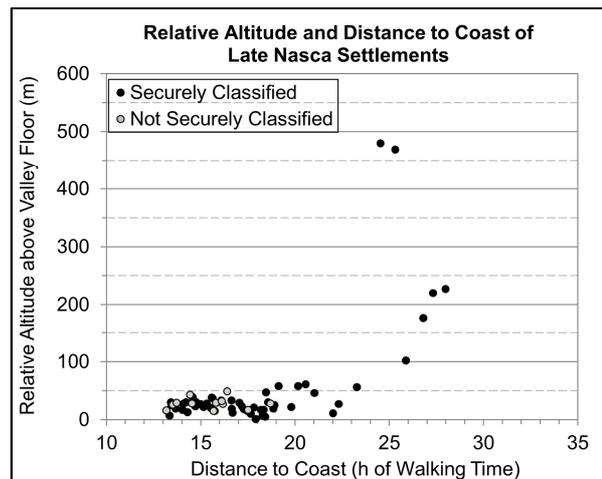


Figure 99: Relative altitude above the valley floors and walking time distance to the coast for Late Nasca settlements. Graphic: VS.

It is difficult to recognize a clear hierarchy among the centers. In the middle Río Grande valley, S-59 at PAP-196 (Parasmarca), S-61 at PAP-180 (Huaraco), and S-57 at PAP-253/255 (Santa Rosa) all contained extended sectors with high-quality formal architecture. S-59 was the largest of the three and was located roughly halfway between the other two. It could have functioned as a local center for the whole middle and upper Río Grande valley, though the possibility that three largely independent polities existed cannot be discarded. At the respective sites, occupations of both the preceding and the succeeding phase were also registered. For this reason it very likely that these three Late Nasca centers were inhabited simultaneously throughout the Late Nasca phase.

Judging from their proximity, it seems likely that the centers along the right margin of the lower part of the middle Palpa valley (S-54 at PAP-42, S-762 at PAP-25/30, S-68 at PAP-16, and S-56 at PAP-4/5) were either part of the same polity or functioned at different times during the Late Nasca phase. The latter is less likely because all but S-54 had a Middle Nasca precursor and thus they probably all existed simultaneously, at least at the beginning of Late Nasca. S-68 contains the most elaborate formal architecture, judging from what is still visible at the surface, and may have functioned as a local center at least for the middle Río Grande valley.

S-53 at PAP-66, the southernmost Late Nasca center, is clearly smaller but also had formal architecture, which suggests a special status of the settlement. It may have been related politically to one of the middle valley polities or functioned as the center of a small independent realm around the tip of the Cresta de Sacramento. S-1032 in the upper Palpa valley contained some larger plazas which could be regarded as formal architecture. This settlement could have been independent, though given the lack of any further formal architecture that might have served administrative functions, it is unlikely that it controlled any other village farther than a few kilometers away.

The three simple centers at the *cabezadas* (S-8 at PAP-814 (Huayuncalla), S-1670 at PAP-902, and S-88 at PAP-759 (Plaza Pampa Este)) show very little elaborate architecture and no contemporary common villages existed close to them. In all three cases, the status seems to have exceeded only slightly that of a common settlement. There are no indications for administrative activities beyond the village level. At S-1670 and S-88, some platforms with perimeter walls constitute the only notable architecture apart from common dwellings. The formal architecture revealed during the excavations of the Palpa Project at PAP-814 (Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013) was not constructed before the Wari Period, but the existence of S-8 is clearly evidenced by layers containing domestic refuse and Nasca 7 sherds. This settlement already seems to have been of considerable size, judging from surface finds, but if it classified as a simple center cannot be determined with any certainty.

6.5.4.4. Major Inter-Phase Developments

The developments during the Late Nasca phase were the logical continuation of the processes that already begun at the end of the Middle Nasca phase. During this time, population continued to decrease, the foothill settlements shifted upstream, and towards the Río Grande valley. Any small local polities that may have existed dissolved rapidly. The total settlement area shrank by 34.5% which is about -0.21% per year on average. The number of settlements at phase start and at phase end is clearly higher than that of *d*-type villages without preceding or succeeding occupations (Figure 101). In contrast to the Middle Nasca phase, during Late Nasca a more or less gradual population development is more likely than a pronounced maximum or minimum at a certain point during the phase. The dislocation rate of 36.4% is the second lowest of all phases and is also evidence against any sudden changes. The majority of the abandoned villages were not been replaced by new ones. The inhabitants rather seem to have left the study area.

The remaining population concentrated along the upper and middle sections of the Río Grande, which is the river with the highest discharge and the most stable water supply. The Palpa and Viscas valleys lost their importance (Map 26). The southernmost villages around the center S-53 were also abandoned. S-59 (Parasmarca) and S-57 (Santa Rosa) presumably maintained a dominant status at least for the middle valley sections during the last decades, but it is also possible that their major political units no longer existed and that most settlements were independent, controlling only their immediate surroundings. The depopulation towards the end of the phase may well have triggered a gradual disintegration of whatever political structure existed before.

Not only the foothills were affected, however, but the three settlements in the lower parts of the *cabezadas*, including S-216 (Suito Orqo) were also abandoned. Only in the upper *cabezadas* a few Late Nasca villages stayed occupied, though S-88 (Plaza Pampa Este) and S-1670 may have lost status and population. Accordingly, Figure 100 shows a single cluster of settlements between 13-19 hours of walking distance to the coast and only four highland villages fall out of this range.

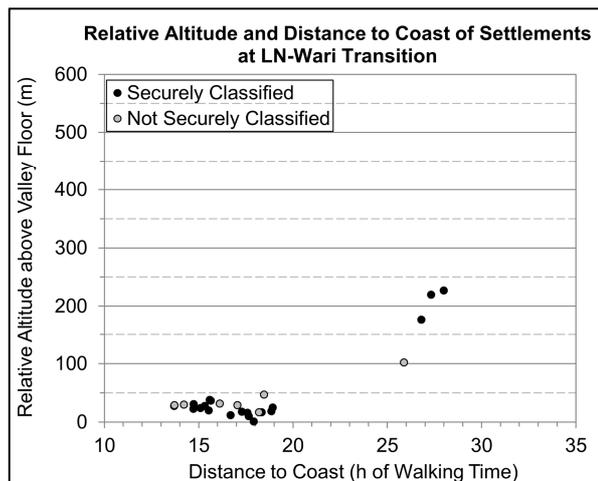
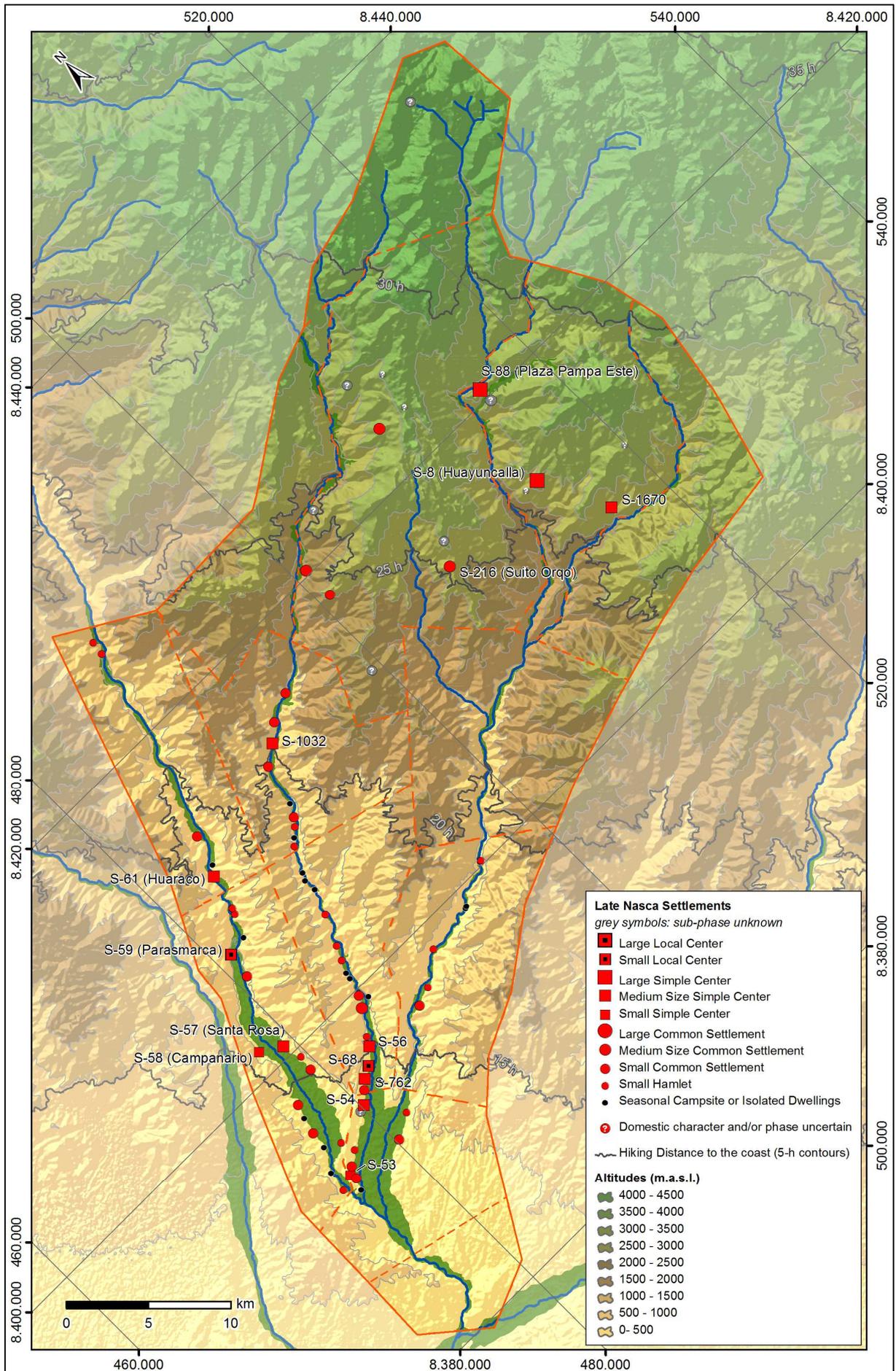


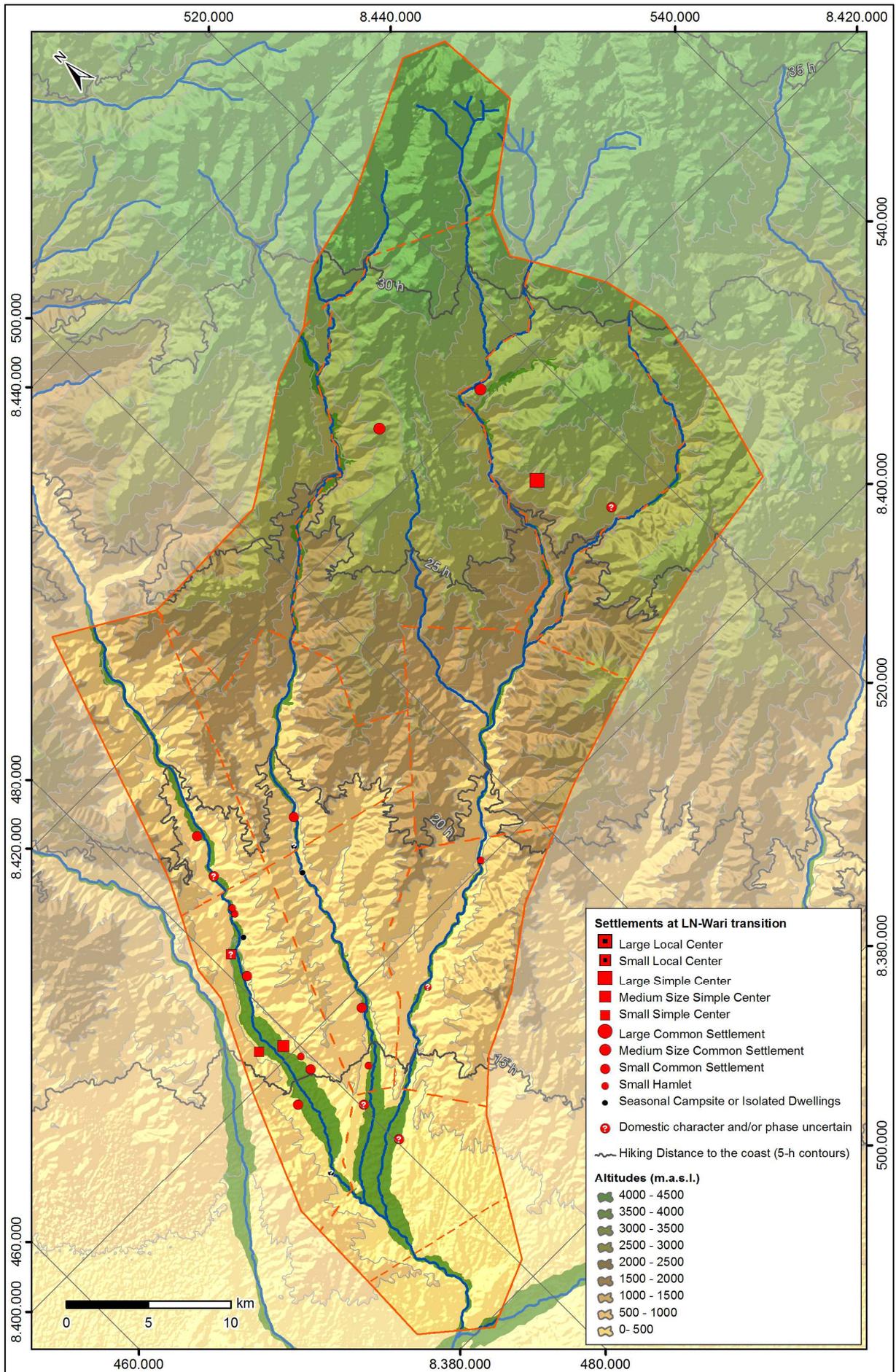
Figure 100: Relative altitude above the valley floors and walking time distance to the coast for settlements at the LN-Wari transition. Graphic: VS.

Late Nasca Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
Phase length			
Likely date: 440 CE	640 CE	Likely length: 200 years	
Earliest possible date: 410 CE	620 CE	Shortest possible length: 150 years	
Latest possible date: 470 CE	660 CE	Longest possible length: 250 years	
Settlement number and area			
	Number	Area	Avg area
Total:	69 (55)	67.15 ha (61.64 ha)	0.97 ha (1.12 ha)
<i>b</i> -type settlements (minimum extent):	11 (9)	10.36 ha (8.61 ha)	0.96 ha (0.96 ha)
At phase start (types a + bS):	36 (25)	35.56 ha (30.73 ha)	0.99 ha (1.23 ha)
At phase end (types bE + c):	26 (23)	23.31 ha (20.56 ha)	0.90 ha (0.89 ha)
Established after phase start and abandoned before phase end (type d):	18 (16)	15.45 ha (13.16 ha)	0.86 ha (0.82 ha)
Growth and dislocation			
Area net growth: -12.26 ha (-10.17 ha)		-34.5 % (-33.1 %)	
Dislocated area: 12.95 ha (11.95 ha)		36.4 % (38.9 %)	
	Likely phase length	Shortest phase length	Longest phase length
Area growth per year:	-0.21 % (-0.20 %)	-0.28 % (-0.27 %)	-0.17 % (-0.16 %)
Population Index:	0.34 (0.31)	0.45 (0.41)	0.27 (0.25)
Status classes			
Number of settlements		Settlement area	
Non-permanent settlements:	0 (0) 0.0 % (0.0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
Common settlements:	56 (42) 81.2 % (76.4 %)	33.04 ha (27.53 ha) 49.2 % (44.7 %)	
Simple centers:	11 (11) 15.9 % (20 %)	28.07 ha (28.07 ha) 41.8 % (45.5 %)	
Local centers:	2 (2) 2.9 % (3.6 %)	6.04 ha (6.04 ha) 9.0 % (9.8 %)	
Administrative posts:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
Administrative centers:	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
Population size classes			
Number of settlements		Settlement area	
Isolated dwellings:	18 (11) 26.1 % (20.0 %)	2.34 ha (1.48 ha) 3.5 % 2.4 %	
Small hamlets:	18 (15) 26.1 % (27.3 %)	5.45 ha (4.52 ha) 8.1 % 7.3 %	
Small settlements:	18 (14) 26.1 % (25.5 %)	17.94 ha (14.22 ha) 26.7 % 23.1 %	
Major settlements:	13 (13) 18.8 % (23.6 %)	32.38 ha (32.38 ha) 48.2 % 52.5 %	
Population centers:	2 (2) 2.9 % (3.6 %)	9.04 ha (9.04 ha) 13.5 % 14.7 %	

Figure 101: Basic data of Late Nasca settlements. Graphic: VS.



Map 25: All settlements of the Late Nasca phase. Map: VS.



Map 26: Settlements probably occupied simultaneously at the transition from the Late Nasca to the Early Wari phase. Map: VS.

6.6 The Early and Middle Wari Phases

The numeric dating of the chronological boundaries of the Early-Middle Wari phase in the study area is problematic. After the current model it spanned the 150 years from 640-790 CE. However, this is based on only four ^{14}C samples, all originating from the small Middle Horizon village S-365 at PAP-93 (Los Molinos), which is associated with sherds of the local Nasca 8 (Loro) style of the Early Wari phase (Unkel et al. 2012:2302). The start of the phase can nevertheless be determined fairly accurately, with the use of complementary datings for the Late Nasca phase from PAP-196 (Parasmarca). Its likely end still is obscure as no secure Late Wari contexts are known from the study area and no samples were dated from contexts associated with sherds of a Middle Wari style (e.g., Atarco). The year 790 CE may therefore mark the end of the Early rather than of the Middle Wari phase. Future dating of samples from Middle Wari contexts may result in a correction of the date marking the phase end.

At the beginning of the Middle Horizon, sherds of the local Nasca 7, Nasca 8 (Loro), and the foreign Chakipampa styles can often be found not only at the same sites but sometimes even in the same layers and contexts. This means that the styles did not develop strictly consecutively but that the periods when they were in use overlap. Perhaps, for a short lapse of time during the late 7th century CE, conservative locals coexisted with those who had quickly adopted cultural elements from the Ayacucho area and maybe also with a small third group of actual immigrants from Ayacucho. By the Middle Wari phase, at least the *cabezadas*, but likely the whole study area, seems to have been formally controlled and administered by Wari officials, as the establishment of several administrative sites with typical Wari architecture suggests.

Though the total number of Middle Horizon settlements (68) nearly equals the respective value for the Late Nasca phase, the average size continued to shrink to 0.77 ha, resulting in a total settlement area of only 52.49 ha. While isolated dwellings (2.7%) and small hamlets (7.0%) together still only made up almost 10% of the overall settlement area, there was a significant increase in small settlements, now comprising 46.8% of the area, the second highest rate of all phases. In contrast, the share of major settlements dropped to 39.0%. Most striking is the very low percentage of only 4.5% for population centers (Figure 107). Very clearly, people chose (or were forced) to live in small, scattered villages rather than concentrating in larger settlements.

6.6.1 Settlement Layout and Construction Techniques

Ceramic sherds of the Atarco style and other styles attributed to the Middle Wari phase (MH2) are rare, but those that were found can mostly be attributed to *cabezadas* settlements while the Early Wari (MH1) Chakipampa style is more common in all of the study area. It often occurs in association with sherds of the contemporaneous but local Nasca 8 (Loro) style, especially at the foothills, where most settlements had direct precursors in the previous phase. Many villages occupied during Late Nasca remained inhabited during the Early Wari phase as indicated by the frequent association of sherds of the local Nasca 7 and Nasca 8 (Loro) styles. Since most of them seem to have decreased in size, population density will have been low. The presence of Middle Horizon tombs at a number of foothill sites - most of them associated with Loro and Chakipampa ceramics (MH1) - is also evidence for a continued settlement activity at least during the earlier phase of the Wari Period. Elaborate MH1 graves were excavated by the Palpa Project in Parasmarca (PAP-196, Figure 97, inlay upper right) and Huaraco/Lucriche (PAP-180), and simpler ones at Los Molinos (PAP-93) and Hanaq Pacha (PAP-733) (Isla Cuadrado 2009:134-136).

Building techniques or settlement layout did not change. Except for the remains of *quincha* walls of simple dwellings belonging to S-365 at PAP-93 (Los Molinos, Reindel & Isla Cuadrado 2001), no domestic or administrative MH structures were excavated at the foothills and all other settlements in the area are only known from surface remains or graves. Apparently, nowhere at the foothills was formal architecture newly erected but some of the existing complexes may partly have remained in use, namely at PAP-196 (Parasmarca, S-571), PAP-253/255 (Santa Rosa, S-62), and PAP-237/238 (Campanario, S-63). The only exception would be S-284 at PAP-940 (Lambrasniyoc) in the upper Viscas valley. Due to its spatial proximity to the *cabezadas* and the similarity in architecture and settlement layout to other *cabezadas* settlements, S-284 was included in the highland pattern described below.

The picture is very different at the *cabezadas*. S-73 at PAP-751 (Ocoro), S-90 at PAP-759 (Plaza Pampa Este), and S-161 at PAP-814 (Huayuncalla) are the only reliably classified settlements with a confirmed Late Nasca precursor. At PAP-902, such a continuity between S-1670 and S-1738 is also possible, but uncertain. In all other cases the settlements were newly established. Unfortunately, in most cases it is not possible to determine a Middle Horizon sub-phase because diagnostic sherds on the surface are extremely rare and often too small to distinguish a certain sub-style. Excavations at PAP-751 (Ocoro), PAP-814 (Huayuncalla), PAP-918 (Chilcapuquio), and PAP-940 (Lambrasniyoc) have revealed that at least the formal architecture seems to have been erected almost exclusively during the Middle Wari phase (corresponding to Menzel's Middle Horizon Epoch 2). The layout clearly follows the Wari architectural tradition suggesting that the people who designed these facilities likely were foreigners from the Ayacucho region.

The formal architecture follows the orthogonal cellular pattern well known from most Central Andean regions belonging to the Wari sphere. It is characterized by more or less rectangular compounds which are internally subdivided into smaller rooms. These rooms are connected by corridors and often arranged around open plazas (Canziani Amico 2009:313-346, Isbell 1991, McEwan & Williams 2012). Most researchers associate orthogonal architecture with some kind of administrative activities or a residential function for elite members. Also ritual uses have been proposed for individual rooms or plazas (Edwards 2010, Schreiber 1992). A second typical type of building, which was probably linked to religious ceremonies, is the D-shaped structure. The largest and best known specimen is located at the site of Wari itself but smaller exemplars are also known from provincial Wari sites (Canziani Amico 2009:313-346, McEwan & Williams 2012:72-74), including S-1740 at PAP-830 (Pacapacari) and S-284 at PAP-940 (Lambrasniyoc) in the study area. Common dwellings, in turn, which arguably housed native people, continue to be round in shape.

Small-scale excavations took place at PAP-751 (Ocoro) in the *cabezadas* of Llauta above the left margin of the Río Palpa (Tomasto Cagigao et al. 2009:141-151). A test pit was dug into an oval-shaped structure belonging to S-73. Its uneven outer walls hardly preserved a single line of stones and in the interior, where a large grinding stone was found, only a very thin cultural layer had formed. This was clearly a simple domestic unit. More impressive are the nine or more *kuntis*, most of them looted, which are scattered over the site. One of the intact structures was excavated and revealed the incomplete and disarticulated skeletons of several individuals, apparently dumped carelessly into the tomb. Some copper *tupus* (cloakpins) and ceramics of the Chakipampa style found between the bones clearly indicate a Middle Horizon date for this burial house.

At PAP-814 (Huayuncalla), Wari Period inhabitants seem to have reused some old abandoned houses originally built during the Middle Nasca phase. Additionally, they constructed new dwellings as well. Extensive excavations also revealed parts of compounds with a rectangular layout covering older round structures from the Initial Nasca phase (Figure 106, Castro de La Mata Guerra García et al. 2012, Reindel & Isla Cuadrado 2013:94-95). The rooms vary in size between 2-4 m at the smaller and 4-8 m at the broader side. Their outer walls were up to one meter thick and built of field stone in the double-face technique. Inner subdividing walls were thinner and not always double-faced. Some did actually serve as retaining walls for low banquettes or pedestals.

At PAP-918 (Chilcapuquio), the bases of most walls belonging to a small complex (S-1673) were surveyed and two rooms were also excavated (Figure 102, Tomasto Cagigao et al. 2009:181-191). The site is located in the *cabezadas* of Ocaña, on the left margin of the Ocaña river. Two compounds of approximately 9x18 and 9x15 m could be identified. These comprised large plazas surrounded by smaller rooms. Excavations were carried out only at the first compound, however. All walls were between 40-100 cm thick and double-faced with a loose fill of earth and gravel. One of the rooms was subdivided by a low retaining wall allowing its back half a slightly higher floor level than the front half. In both compounds the walls are neither exactly straight nor do they form exact right angles. While by trend following the orthogonal cellular pattern, architects apparently were not particularly concerned with precision. Since representative architecture can be expected to be built with special care, it is likely that the structures were purely functional.

S-284 at PAP-940 (Lambrasniyoc) was located strategically at the confluence of the Río Viscas and the Quebrada Camajayoc which originates in the fertile Locchas basin.¹¹⁷ Since this basin has a favorable microclimate, it has been cultivated intensively until the present day. This is evidenced by

¹¹⁷ The *quebrada* splits up into several branches, each of which has a different name. The principal branch is called Quebrada Socos farther upstream and Quebrada Huichulca in its headwater area in the Locchas basin. When I use the name Quebrada Camajayoc, I am referring to the entire main branch, not only to its lowermost section.

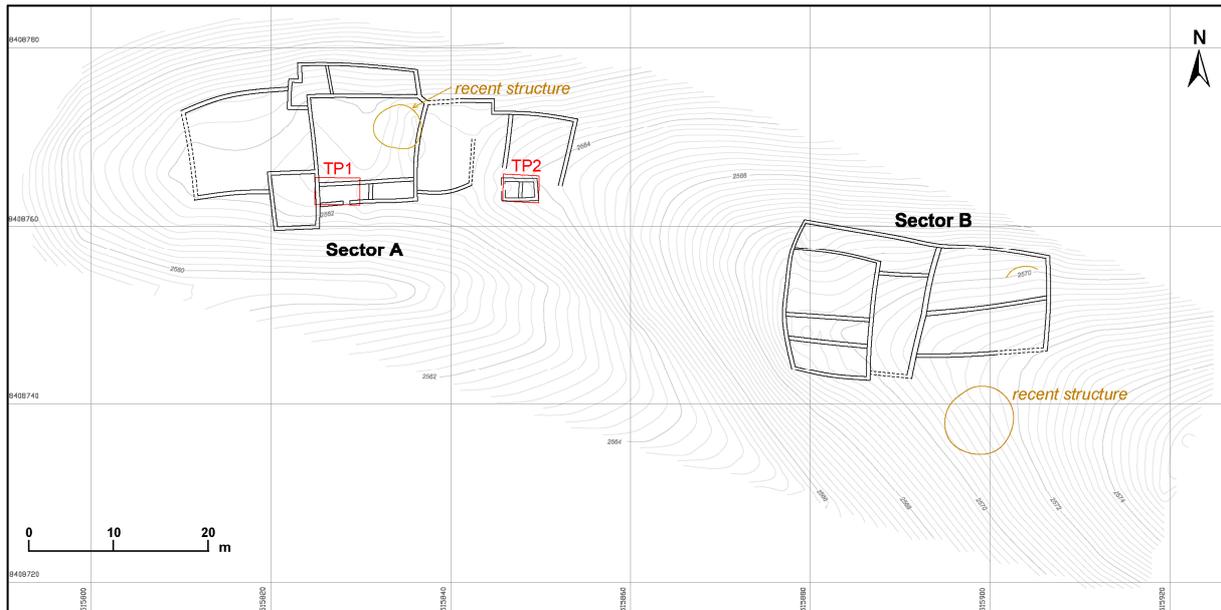


Figure 102: Plan of S-1673 at PAP-918 (Chilcapuquio). Survey plan: Palpa Project, modified by VS.

numerous agricultural terraces covering much of the slopes. At PAP-940, besides some rectangular structures and construction terraces, a D-shaped building of about 7x7 m can be observed (Reindel & Solís Quinteros et al. 2010). Several ruins have been reused as pens by present-day inhabitants of the area but the original parts of the walls, still partly preserving up to 2.5 m in height, can easily be distinguished from recently added or re-erected ones. A test pit dug into the D-shaped structure revealed some architectural details, in particular a low banquette of about 80 cm wide and 40 cm high, and a step at the entrance, indicating that the interior floor lay above the exterior. Furthermore, two *kuntis* are located close to the described architecture. S-284, to which all structures can be attributed, was only about one hectare in size. The presence of rectangular and D-shaped buildings nevertheless suggests that the settlement was of some importance.

There are several further important Wari settlements where no excavations have taken place. An especially interesting example is S-1740 at PAP-830 (Pacapacari) high above the right margin of the Palpa river (*cabezas* of Huac Huas). It included two large, exceptionally well-preserved D-shaped structures with a diameter of roughly 8-9 m, which can still be seen alongside several smaller buildings (Figure 103). The latter had partly been modified and extended in modern times to serve as pens. Their original shape could therefore not be distinguished. Additionally the bases of at least 10 round structures, probably houses, are observable. The large D-shaped buildings have thick double-face stonewalls coated with a clay plaster and featuring several small niches. About 12 to 15 *kuntis* of different designs can be found at the site.

S-121 at PAP-780 (Mauka Llaqta) above the left margin of the upper Laramate valley (*cabezas* of Llauta) is less well preserved and heavily overgrown by shrubs and cacti but the basements of several rectangular structures are still recognizable. It would take an excavation or at least an extended clearance of the site to fully reveal their arrangement. A D-shaped structure also seems to have existed but only the base is recognizable. About 15 *kuntis* of different designs were arranged around the settlement.

S-1682 at PAP-967 (Ayapampa) was located on a terraced, broad, and smoothly descending, spur above the left margin of the uppermost Palpa valley (*cabezas* of Llauta), right in the center of a fertile valley pocket. Though the vegetation cover does not allow a full recognition of architectural patterns, the remains of adjacent rectangular structures are clearly visible (Figure 104). At least two opposing lines of rooms up to 5x10 m in size and a corridor running between them could be identified. In front of these, several levels of large rectangular platforms can be observed, the largest measuring about 11x55 m. At least ten *kuntis* are scattered between the surrounding agricultural terraces.

Fairly isolated agglutinating rectangular structures forming small buildings or complexes can be found in different locations of the *cabezas*, but all below the 3000 m contour. They may have administrative posts, perhaps serving as roadhouses along the way to the foothills (and from there to the coast). In case of S-1718 at PAP-879 (Tranca) and S-1723 at PAP-788 (Santa María) the cultural affiliation is relatively clear while the buildings at PAP-1105 (S-1637), PAP-1106 (S-1639), and PAP-1094 (S-

1635) in the upper Palpa valley may also date to the Late Horizon or even to the colonial period. As no diagnostic material could be found on the surface, excavations are necessary to clarify the time of construction.



Figure 103: D-shaped buildings of S-174 at PAP-830 (Pacapacari). The smaller structure in the foreground includes at least one ancient wall (the back wall) while parts of the outer walls are recent additions. Photo: VS.



Figure 104: The rectangular compound of S-1682 at PAP-967 (Ayapampa). While the outer walls are well visible, the internal structures are difficult to recognize due to vegetation cover. Photo: VS.

6.6.2 Settlement Location and Subsistence

Newly established high-altitude herder settlements were located at a walking distance from the coast of up to 34 hours. The lower limit of the settled area, in turn, stayed roughly the same as in the previous phase (13-14 hours) because the lower Río Grande valley and most of the great floodplain remained unsettled (Figure 105). The ongoing decrease of settlement density at the foothills may point to worsening conditions for irrigation agriculture. Most LN settlements in the middle and upper Palpa valley were abandoned and hardly any village was left in the Viscas valley that was still sparsely populated in the previous phase. Only the Middle Río Grande valley, where the river runoff is higher

than in the other two valleys, maintained some importance as settlement area although here as well, population seems to have diminished (Map 27).

At the *cabezadas*, in turn, settlement density rose. Virtually all of the small settlements which fall within the present-day limits of the *suni* and *puna* ecozones are associated with pens and were obviously inhabited by camelid herders. Herding apparently played a more important role than in previous phases but not a dominant one. The placement of major centers like S-1682 (Ayapampa) and S-121 (Mauka Llaqta) in areas with especially extended agricultural terraces on relatively moderate slopes clearly indicates that farming still was the principal column of food production also in the *cabezadas*. Unfortunately, the dating of agricultural terraces is a difficult task and a full coverage investigation of the hundreds of hectares of terraced slopes would require a separate and well-funded long-term project. For now it is not possible to tell to what extent terraces were built or reused during Wari times. However, the increase in settlement density and the association of several important Wari settlements with surrounding terraces suggest that many of them may actually have been constructed during the Middle Horizon. Schreiber (1987) proposed a method for indirect dating by observing cutting, superposition, and spatial relations between terraces and other structures, including houses and roads. This approach might also prove useful for future studies in the *cabezadas* of the Río Grande drainage.

6.6.3 Hierarchy and Defensive Measures

During the Early-Middle Wari phase, there were still nearly no foothill villages located high above the valley floor and those at the *cabezadas* were predominantly herder settlements located on vast *puna* plains (Figure 105). They were clearly established there to exploit pastureland available in the surroundings and not for any defensive considerations. Not a single Middle Horizon site anywhere in the study area had defensive walls, sling stone deposits, or any other feature clearly pointing to armed conflict. There seems to have been a wide unsettled section between foothills and *cabezadas*, which could be interpreted as a kind of buffer zone. More likely, however, the relatively narrow upper valley floors were not attractive for cultivation (and thus not for settlement) while population levels were low and while better suited patches of land were readily available.

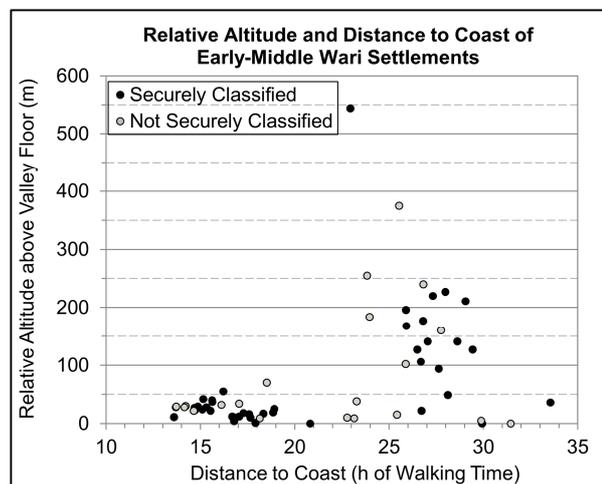


Figure 105: Relative altitude above the valley floors and walking time distance to the coast of the Early-Middle Wari phase. Graphic: VS.

Common settlements made up for 62.4% percent of the overall settlement area while only 5.9% correspond to simple centers which had been established and inhabited by locals. In turn, 9.2% belong to foreign administrative posts and fully 22.0% to foreign administrative centers where architecture and cultural material point to the presence of colonists from the Wari heartland in the Ayacucho region (Figure 107). These settlements may also have housed locals but were clearly designed and dominated by Wari people. Interestingly, formal Wari architecture can be found exclusively at the *cabezadas* but not at the foothills.

At the foothills, only at PAP-196 (Parasmarca, S-571), PAP-253/255 (Santa Rosa, S-62), and PAP-238 (Campanario, S-63) in the middle Río Grande valley the LN formal architecture stayed in use for some time at least partly but it is doubtful if from here larger valley portions were administered. Given the scattered pattern of small common settlements, each may have controlled only the fields with the most reliable water supply in a wider area and may have been more or less economically self-sufficient. All three settlements were therefore classified as simple centers.

The situation is different at the *cabezadas* where four foreign administrative centers and half a dozen smaller administrative posts were identified. The existence of *kuntis* and the fact that the formal architecture is of Wari-style clearly demonstrates that Wari people controlled these places. This is true even though the presence of local-style simple dwellings and ceramic sherds suggests that local people made up a good portion of the inhabitants and likely even were in the majority. There is no obvious reason to doubt that the study area formed part of the greater Wari realm, and thus the

mentioned installations have to be regarded as lower ranking provincial administrative facilities which were subject to directives from either the Wari capital itself or from an intermediate regional center.

6.6.4 Major Inter-Phase Developments

Through the Early Wari phase many Late Nasca foothill settlements continued to be occupied. The moderate increase in settlement density at the *cabezadas*, in turn, can probably be largely attributed to the Middle Wari phase. Most foothill villages were arguably already abandoned when the foreign administrative centers were established in the highlands. As no Middle Horizon site registered so far contains a clear domestic occupation of the Late Wari phase, the entire study area seems to have been depopulated almost completely by the end of the Early-Middle Wari phase.

It can be assumed that some settlers remained in the study area during the Late Wari phase living in small and simple hamlets that have yet not been identified. The loss of population must nevertheless have been dramatic. If it was a steady process, population would have decreased by about 8% per year on average, but it is much more likely that there was first a phase of relative stability and afterwards a more or less rapid emigration. Otherwise it would not have made sense to invest in the establishment of several administrative centers in an area where problems in maintaining the existing population were already pressing. The Middle Wari phase may actually have lasted well into the 9th century, as already noted, while the date of 790 CE may only indicate the end of the Early Wari phase and perhaps the abandonment of the foothills. Due to this dating uncertainty, statistics based on phase length, including the rate of average yearly growth of settlement area and hence of population, are of doubtful reliability.

Most foothill sites with Middle Horizon domestic occupations are associated with MH1 material of the local Nasca8/Loro and, to a lesser degree, the Ayacucho derived Chakipampa styles while the formal Wari architecture excavated at PAP-814 (Huayuncalla) and PAP-918 (Chilcapukio) contained MH2 sherds. Despite the issue that many sites, especially at the *cabezadas*, show surface material which currently can only be classified as Middle Horizon in general, the available data suggests significant changes in settlement patterns between Early (MH1) and Middle Wari (MH2). Settlement density at first further decreased at the foothills while only a few small villages were newly established at the *cabezadas*. There is still no clear evidence for a formal Wari domination but people from the Ayacucho region may already have been present. Later on, in the Middle Wari phase, the study area and probably the entire Nasca drainage was formally integrated into the Wari Empire and the Wari administrative system, which became manifest in the construction of several small and medium sized orthogonal complexes, probably constituting administrative facilities.

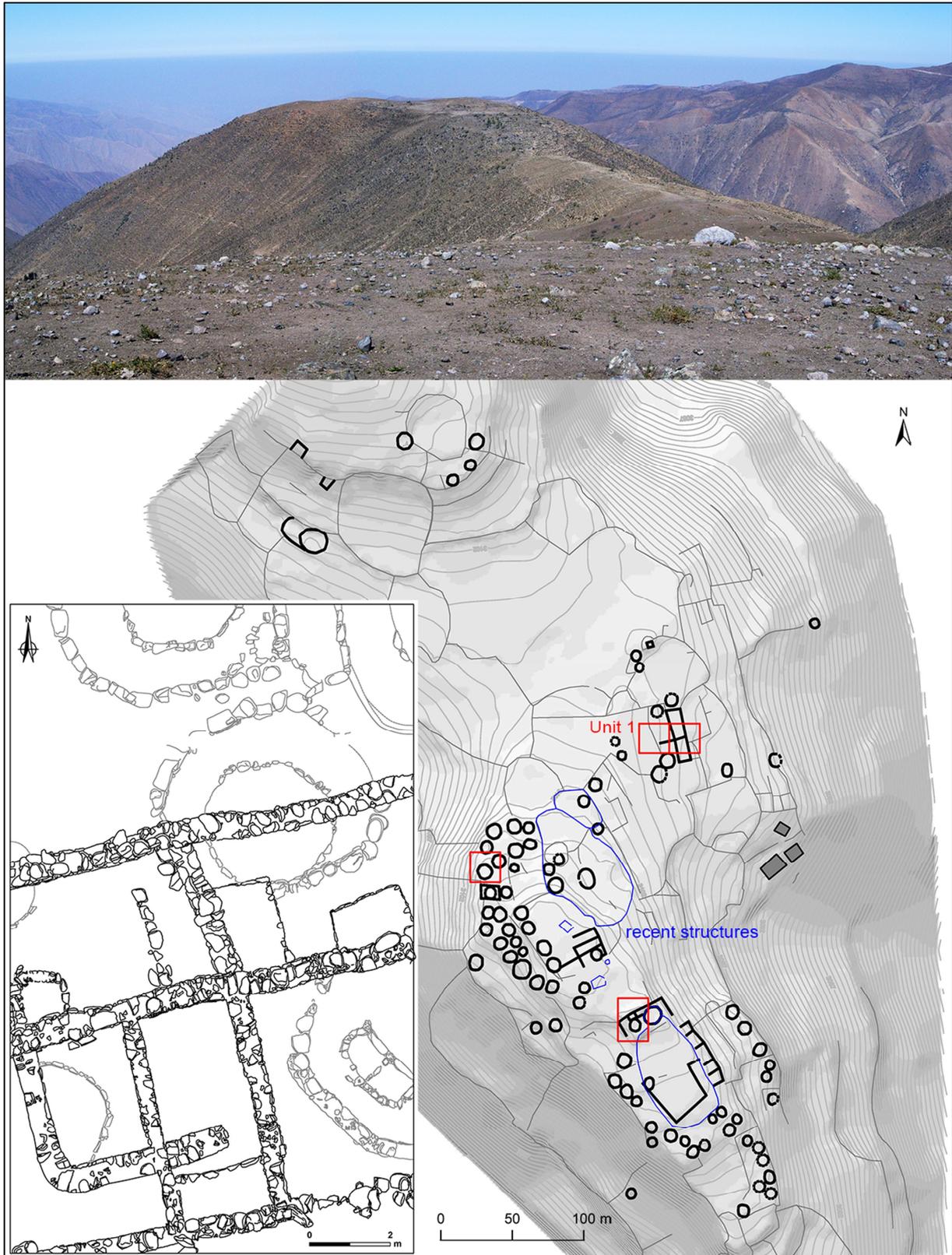
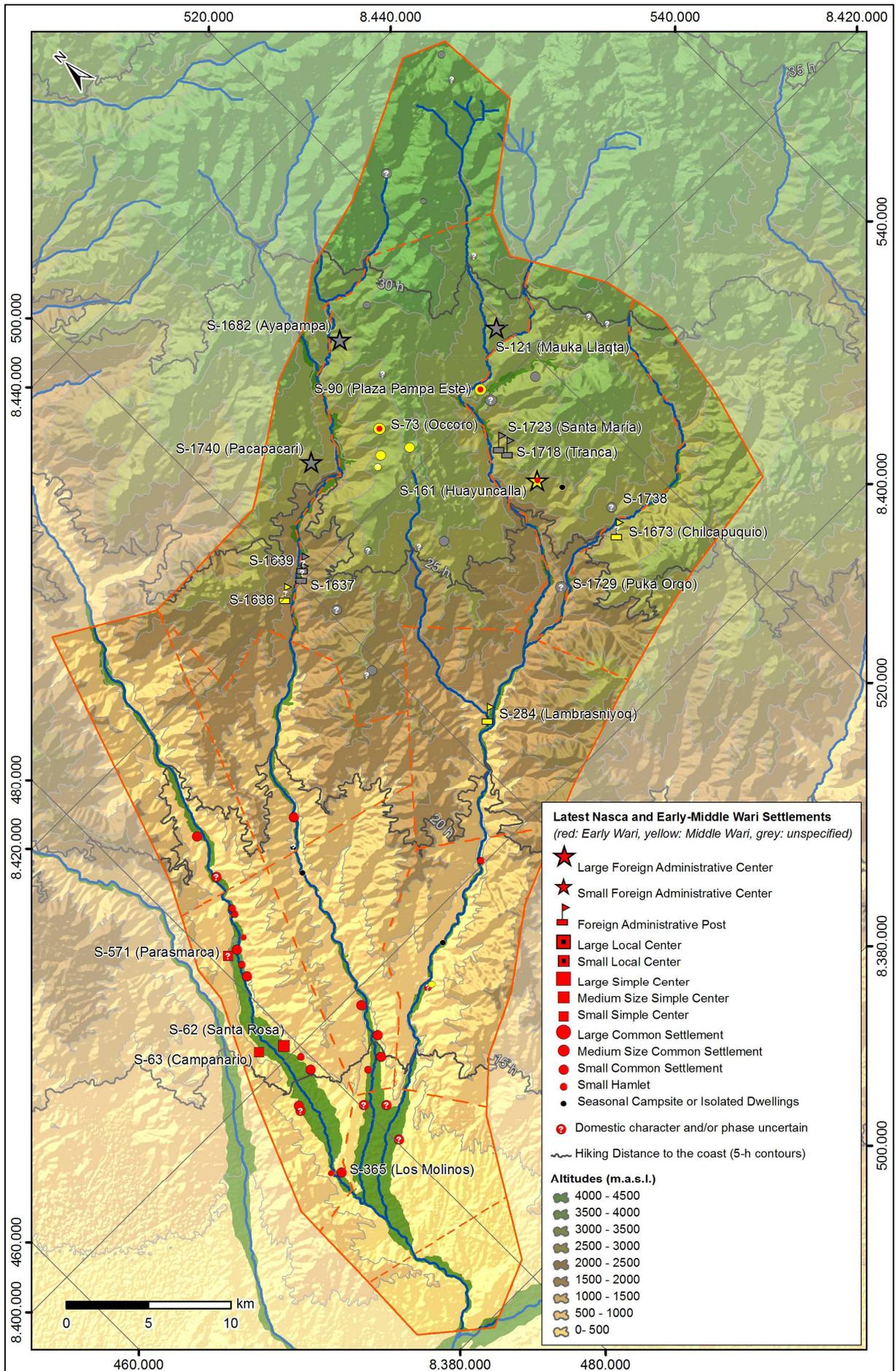


Figure 106: Panoramic view (top) and survey plan of PAP-814 (Huayuncalla). Lower left: Rectangular structures belonging to S-161 covering parts of a Late Paracas/Initial Nasca flower structure (excavated in unit 1). Photo, drawing, and survey plan: Palpa Project, modified by VS.

Early-Middle Wari Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	
<i>Likely date:</i> 640 CE		790 CE	
<i>Earliest possible date:</i> 620 CE		790 CE	
<i>Latest possible date:</i> 660 CE		850 CE	
		Phase length	
		<i>Likely length:</i> 150 years	
		<i>Shortest possible length:</i> 130 years	
		<i>Longest possible length:</i> 230 years	
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
<i>Total:</i>	68 (42)	52.49 ha (39.73 ha)	0.77 ha (0.95 ha)
<i>b-type settlements (minimum extent):</i>	0 (0)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
<i>At phase start (types a + bS):</i>	27 (19)	23.31 ha (18.30 ha)	0.86 ha (0.96 ha)
<i>At phase end (types bE + c):</i>	0 (0)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	41 (23)	29.18 ha (19.58 ha)	0.71 ha (0.85 ha)
Growth and dislocation			
<i>Area net growth:</i> -23.31 ha (-18.29 ha) -100.0 % (-100.0 %)			
<i>Dislocated area:</i> 0.00 ha (0.00 ha) 0.0 % (0.0 %)			
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
<i>Area growth per year:</i>	-7.91 % (-7.76 %)	-9.07 % (-8.90 %)	-5.23 % (-5.13 %)
<i>Population Index:</i>	0.35 (0.26)	0.4 (0.31)	0.23 (0.17)
Status classes			
Number of settlements		Settlement area	
<i>Non-permanent settlements:</i>	7 (1) 10.3 % (2.4 %)	0.24 ha (0.02 ha) 0.5 % (0.1 %)	
<i>Common settlements:</i>	47 (32) 69.1 % (76.2 %)	32.76 ha (22.45 ha) 62.4 % (56.5 %)	
<i>Simple centers:</i>	3 (2) 4.4 % (4.8 %)	3.09 ha (2.55 ha) 5.9 % (6.4 %)	
<i>Local centers:</i>	0 (0) 0.0 % (0 %)	0.00 ha (0.00 ha) 0.0 % (0 %)	
<i>Administrative posts:</i>	7 (3) 10.3 % (7.1 %)	4.85 ha (3.15 ha) 9.2 % (7.9 %)	
<i>Administrative centers:</i>	4 (4) 5.9 % (9.5 %)	11.55 ha (11.55 ha) 22.0 % (29.1 %)	
Population size classes			
Number of settlements		Settlement area	
<i>Isolated dwellings:</i>	18 (7) 26.5 % (16.7 %)	1.43 ha (0.58 ha) 2.7 % 1.5 %	
<i>Small hamlets:</i>	12 (9) 17.6 % (21.4 %)	3.66 ha (2.86 ha) 7.0 % 7.2 %	
<i>Small settlements:</i>	29 (19) 42.6 % (45.2 %)	24.54 ha (17.02 ha) 46.8 % 42.8 %	
<i>Major settlements:</i>	8 (6) 11.8 % (14.3 %)	20.48 ha (16.89 ha) 39.0 % 42.5 %	
<i>Population centers:</i>	1 (1) 1.5 % (2.4 %)	2.39 ha (2.39 ha) 4.5 % 6.0 %	

Figure 107: Basic data of Early-Middle Wari settlements. Graphic: VS.



Map 27: All settlements of the Early-Middle Wari phase. Map: VS.

6.7 The Middle-Late Ica & Inca Phases

The exact beginning of Late Intermediate Period in the study area cannot be pinpointed with certainty. No archaeological contexts associated with sherds of the Early Ica style have so far been documented and the earliest date available for a Middle Ica context is 1180 CE. Accordingly, there is a wide gap of 390 years between the oldest date attributed to the Wari Period (790 CE) and the earliest date for the Ica Period. It will probably be narrowed down when additional ^{14}C samples are processed. Yet nevertheless, there seems to have been a hiatus of several hundred years in the settlement history of the NGD. The end of the Late Ica phase is also controversial. From ethnohistoric sources it can be deduced that the definite incorporation of the whole Río Grande drainage into the Inca Empire took place in the early 1470s CE, while contact with the expanding Inca state may have occurred as early as 1440 CE (see Chapter 3.2.4.5). Although Inca-style sherds and architecture are easily distinguishable from those of local tradition, it is generally not possible to say whether a particular settlement was occupied during the Late Horizon (1470-1532) if no such indicators are observable. In many LIP settlements, imported Inca wares or local imitations were apparently not used nor were Inca officials and the related administrative architecture present. As the local styles did not change significantly for several hundred years, a reliable distinction between LIP and LH settlements is not possible on the basis of surface remains. Both are therefore treated together in the general statistics and on the distribution map (Map 28).

The diagnostic local ceramics that can be found at the foothills and (in lesser quantities) at the *cabezadas* are very similar, though not identical, to those from the Ica valley. Close cultural, but not necessarily political, ties between the foothill sections of the Río Grande drainage and the Ica valley may also have existed (Conlee 2005, Otten 2009, Reindel & Isla Cuadrado et al. 2010). For this reason, I call the LIP in the NGD the Ica Period. Ethnohistoric sources (e.g., Garcilaso de la Vega) refer to the local population in the Río Grande drainage as “Nanasca” (not to be confused with the Nasca culture of the Early Intermediate Period). There is very few if any cultural continuity observable in the archaeological record between the Nanasca population and that of earlier phases. Apart from limited similarities in vessel forms and decorations, Nanasca settlements, contrary to Wari installations, are sometimes built on top of Nasca geoglyphs, which apparently had completely lost their meaning (Lambers 2006).

From ethnohistorical sources it is known that the *cabezadas* were inhabited by the Rucanas Laramati, a group ethnically different from those people who had reoccupied the foothills. It was closely related to the Rucanas Andamarca and the Soras on the eastern side of the *puna* (Meddens & Schreiber 2010, Schreiber 1993). The Rucanas used Ica-style ceramics in addition to undecorated vessels. Since undecorated highland wares from all phases remain a research desideratum, it can currently not be determined confidently whether these were produced locally. Future studies of LIP ceramics from the *cabezadas* may also reveal pieces comparable to those excavated by Sarah Abraham (2010) at Pulapuco in the headwaters of the Acarí river and close to the present-day town of Puquio.

During the Middle-Late Ica & Inca phase population density must have reached an all-time high, surpassing even present-day levels. This is likely even though the phase length of about 350 years to a certain degree relativizes the large number of settlements (188) and especially the overall settlement area of 395 ha. Many villages may have been occupied successively rather than simultaneously. On average, Nanasca settlements covered 2.1 ha, but their size was extremely variable and ranged from less than 0.1 ha to almost 30 ha. Due to the drastic increase in average settlement size, the percentages of the total settlement area of isolated dwellings (0.8%), small hamlets (2.4%), and small settlements (11.2%) are much lower than in any other phase. Even major settlements only accounted for 28.2% of the overall area. In contrast, population centers made up for fully 57.4% (Figure 118). The phenomenon that the majority of the population concentrated in large towns is new and not observable at this scale in any previous phase. Another conspicuous aspect is the overwhelming evidence for armed conflict and defensive concerns.

6.7.1 Settlement Layout and Construction Techniques

During the Middle-Late Ica & Inca phase many exceptionally large settlements were established at both the foothills and the *cabezadas*, but layout and construction technique in both areas differ markedly. When the study area became part of the Inca realm, some buildings and a few settlements designated to imperial administrative needs were newly erected. These can often be distinguished by

their particular layout and building technique. Nevertheless, many Nanasca and Rucanas settlements probably continued to thrive fairly unchanged.

6.7.1.1. Nanasca Foothill Settlements

At the foothills, agglutinating angular rooms arranged along streets and pathways predominated. The rooms varied in shape between roughly quadrangular and elongated rectangular, and typically measured less than 12 m². Interior *quincha* or single-face stonewalls may have served as partitions.

Excavations at LIP foothill settlements have so far been limited to a few test pits at PAP-113 and PAP-115, both sites forming part of S-469 (Pinchango), and at PAP-396 (Chillo), whose domestic occupation corresponds to S-332 (Reindel & Isla Cuadrado et al. 2010:269-276). However, preservation of surface architecture is relatively good at many sites, allowing some detailed observations without digging. Three basic types of construction are distinguishable: full-height double-face stonewalls (Figure 108c), low stone murals with *quincha* walls on the interior (Figure 108d), and at slopes, subdivided terraces where the rooms incorporate the retaining wall of the upper terrace as a back wall (Figure 108a). The interior faces generally had a clay plaster which may also have been painted, though no color is preserved (Figure 108c). There are also walls built of stones that were carefully chosen by size and color and placed in a way that they structure the visible wall face (Figure 108a/b). Since this arrangement served decorative purposes rather than technical needs, no plaster was applied. Very frequently, stone-lined storage pits were dug in the corners of rooms. Storage, though on the household level, seems to have played a more prominent role than in most previous phases due to denser population but probably also due to concerns about prolonged conflicts and other crises.



Figure 108: Examples of Ica Period architecture at the foothills. a) Architectural unit belonging to S-312 at PAP-425 incorporating the retaining wall of a construction terrace as a backwall. Note the careful choice of the employed stones by size and color. b) Detail of a wall at the same site with sections of smaller stones placed in a diagonal pattern alternating with bands of larger horizontally placed stones. c) Well preserved room defined by freestanding stonewalls with clay plaster belonging to S-489 (Pinchango) at PAP-115. d) Rooms with low double-face outer murals and remains of *quincha* walls on the inside belonging to S-332 at PAP-396 (Chillo). Photos a) and b): VS, photos c) and d): Palpa Project.

The best documented Nanasca settlement currently is S-469, not so much due to some limited excavations but because its well-protected high-elevation sector PAP-114 (Figure 114) was carefully surveyed and modeled in 3D in 2004 and the following years by the Palpa Project in cooperation with

a team of geodesists from the ETH Zürich (Eisenbeiss 2009).¹¹⁸ PAP-114 is located on an inclined plateau at the northern end of the Cresta de Sacramento, amidst the southern foothills of Cerro Pinchango. Due to impassable scarps, access to the site from the east and the south is only possible via a few *quebradas* but these are blocked or at least controlled by a system of multiple walls. The plateau is entirely covered by the remains of structures most of which correspond to dwellings which can be assigned to the first construction type: full-height double-face stonewalls. Rooms seem to have been arranged in patio groups which, in turn, were connected to each other by narrow lanes. No obvious master plan is recognizable and the arrangement of the numerous structures gives a rather organic impression. Some of the domestic units seem to have included not only simple storage pits but a cellar-like facility below the floor.

The slopes below the western edge of the plateau are less steep and their middle and lower reaches were also used for construction. This area already forms part of PAP-113 and PAP-115 but was obviously connected to PAP-114. The structures continue into flatter terrain towards the margins of two broad *quebradas*. In these sectors, some of the architecture can be classified as well-planned and formal, especially two large walled plazas with surrounding smaller rooms, one (at PAP-115) measuring 40x33 m and the second (at PAP-113) measuring 26x16 m. No obvious Inca installations have yet been identified.

Since S-469 was located close to S-448 at PAP-128 (Las Colcas) only about 2 km upstream, these two centers may have been closely related and probably functioned together. S-448 also comprises some domestic terraces on a hill slope (PAP-127) but the larger portion (PAP-128) lay in relatively flat terrain in the interior of a broad *quebrada* and on a narrow spur delimiting it to the north. Most of the angular, agglutinating structures will have been dwellings but at least one compound can be regarded as formal architecture and may have served administrative purposes. It consists of an almost square plaza of 13x15 m surrounded on three sides by directly adjacent rooms of different sizes. There are more structures that might classify as formal but their preservation is too poor to draw any further conclusions without excavation or at least a detailed survey. Atop of the mentioned spur, a string of 13 rooms can be observed, ranging in size between 2x3 and 5x7 m. These could be interpreted as storage facilities which gave the site its popular name: "Las Colcas," meaning "The Storerooms." If this interpretation is correct, the structures could hint to a practice of stockpiling beyond the household level.

The largest Nanasca settlement in the study area was S-1114 (Cerro Mollake), comprising several sites on both sides of the mountain spur dividing the Palpa and the Viscas valleys. On the Viscas side, it incorporates PAP-650 and PAP-649 where the remains of numerous structures of the third construction type (terraces) can be observed. These are located on a slope which is moderately inclined in its lower reaches close to the valley margin but becomes steeper in its upper section. In the lower section, there are also some larger open terraces, perhaps serving as working spaces. When they were first documented the uppermost terraces were thought to have served only as a protection against tumbling boulders but a closer inspection in 2011 revealed that domestic units stretch over the entire slope from the valley margin at about 520 m.a.s.l. up to about 850 m.a.s.l.

A similar situation is observable on the Palpa side where PAP-452 was thought to end at an altitude of approximately 750 m.a.s.l. In fact, structures and terraces continue up to the mountain peak itself. The structures start in a dispersed pattern already high above the valley floor but on a flat elevated plateau at the foot of a spur running down from Cerro Mollake. The slopes of the spur itself are densely covered by the remains of construction terraced and dwellings, many of which show storage pits or small interior closets of no more than about a meter in diameter. At a certain altitude, the spur narrows to a ridge but the terraces still continue, although the site was originally thought to end here.

In order to keep consistency with the existing documentation, I registered the upper area in 2011 as a new site – PAP-2003 – but this is a purely technical separation. At the narrowest section of the ridge, the terraces were built especially high and massive, and on their copings, numerous sling stones were deposited. There are at least five of these terraces arranged in stairs, one behind the other. Obviously,

¹¹⁸ The site was first surveyed terrestrially by members of the Palpa Project. The tachymeter measurements were carried out by M. Zwicker. These data were later combined with a digital surface model derived through the photogrammetric processing of aerial photos taken by a remotely controlled model helicopter.

Also see Reindel 2005 for some general information. Personally, I disagree with the idea proposed in the mentioned article, that PAP-114 was in first place a mining settlement. There are many other contemporary sites with similar characteristics, including large grinding stones, but there is no clear evidence for gold mining at a large scale involving hundreds of workers. Nevertheless, metal production may well have been an occasional, secondary economic activity.

the mountain top served as a kind of acropolis and access to it was restricted. The slopes immediately below are all terraced and covered by domestic structures while at the top itself the remains of several agglutinating rectangular rooms can be observed. There are also numerous looted tombs and possibly some of the structures might have been built originally for funeral purposes. The abundance of domestic refuse and the presence of a number of grinding stones nevertheless leaves no doubt that people actually lived here. To the northeast, the mountain crest serves as an alternative travel route towards the *cabezas*, avoiding the valley floors. Access to the settlement is blocked here by a large natural black rock, atop and beside of which sling stones were piled up. In this way, control of access was assured from this side as well. East of the mountain top, the terraces more or less blend into the uppermost ones of PAP-650. In sum, S-1114 comprises 30 ha of continuous settlement area stretching from the margin of the Viscas valleys across the mountain top down to the middle slopes and the elevated plateau on the Palpa side.

Comparable to the case of S-469 and S-448, there is a smaller but important settlement about 1.5 km upstream of S-1114 in the Palpa valley: S-873 at PAP-475. It is located on a moderate slope relatively close to the valley margin but more than 50 m above the valley floor. It predominantly consists of domestic terraces and dwelling structures of the third type. In the less inclined section of the southern part of PAP-475, however, some larger rectangular compounds with adjacent rooms and internal subdivisions can be observed, the largest one measuring 11x16 m. Noticeable quantities of sherds from oversize coarse ware storage jars as well as grinding stones can be found here which may hint to the procession and storage of goods, especially grain, beyond the needs of individual households.

6.7.1.2. Foothill Settlements Including Inca Architecture

When the Inca incorporated the South Coast into their empire, a number of administrative facilities were built using a typical Inca-style layout and a construction technique distinct from local architectural traditions. These were either placed in or next to existing settlements or in newly established provincial capitals. The study area is no exception. The whole foothill section was arguably governed from the newly built administrative center S-1048 at PAP-405 (Pueblo Nuevo/Tambo de Llipata). Although the site is completely destroyed by now, its general layout can be derived from old aerial photos from 1944 (Figure 109, also see Reindel 2009:458-460) as well as from a sketch plan by Mejía who visited it in 1927 (Novoa Bellota 2002:212-214).¹¹⁹



Figure 109: The Inca administrative center S-1048 at PAP-405 (Pueblo Nuevo) on the SAN aerial photo 524-400, taken in 1944. The site has been completely destroyed in the 1950, but from the photo, the typical layout of Inca administrative centers is clearly recognizable. Photo: Servicio Aerofotográfico Nacional.

Additionally, remains of intrusive Inca installations can be found in some important Nasca settlements, for example in S-312 at PAP-424/425. This large town was located in a strategic position at the confluence of the Grande and Ingenio rivers where important settlements had already existed in Nasca times. The Nasca core settlement may already have covered about 10 ha of slopes and *quebrada* floors surrounded by hill chains and surely housed a substantial population. Access to the naturally defensive location was further restricted by walls and sling stone deposits on the hilltops from where movements within several kilometers could be observed.

The Inca installations, in turn, are located directly at the valley margin to the south (PAP-424) and southwest of the central habitation area. The whole southwestern sector of PAP-425 lies just outside the limits of the study area and was not documented by the Palpa Project.¹²⁰ It comprises a complex mosaic of small domestic units, especially close to the hills, and large rectangular plazas, all heavily

¹¹⁹ In 1957, the site was registered as PV67-23 by Mejía Xesspe, who named it "Tambo de Llipata" (Mejía Xesspe 1976:38-39). He had visited and mapped it before in 1927 together with the much smaller but contemporaneous administrative post at PAP-406 (S-327) during a short excursion with Tello (Novoa Bellota 2002:212-214).

¹²⁰ The site falls within the survey area of Helaine Silverman who concentrated on Nasca sites. Possibly, she made field notes but no published information is available.

affected by looting. It is very possible that a good part of this sector had already been occupied before the arrival of the Inca, who later added some buildings. This is indisputable since cuboid *adobes*, which are only known from Inca architecture, were used for some structures (cf. Figure 22). At PAP-424, a large rectangular plaza of 23x67 m with an adjacent row of six smaller units of 11x9 m can be observed. The double-face stone murals are very low, however, and it can be assumed that the actual walls and perhaps roofs were made of light *quincha*. Since the construction technique of the walls follows the local tradition, it is not clear whether these structures were newly erected after the Inca conquest or if they had already been in use.

In turn, in S-720 at PAP-292, parts of a complex of rectangular structures were built of diagnostic Inca-type cubic *adobes*. These structures were most likely administrative facilities established here by the Inca for the governance of the adjacent, large but simple Nanasca settlement S-719 (Carapo) and perhaps the whole upper part of the great floodplain and the middle Palpa and Viscas valleys.

Another example of Inca building activity in existing Nanasca settlements is S-1746 at PAP-224 in the Middle Río Grande valley, at a point where it is closest to the Santa Cruz valley. The Nanasca occupation seems to have been modest in size and consisted mainly of simple domestic terraces along the southern slope of a spur reaching into the valley. The Inca then erected a complex of rectangular rooms, plazas, and connecting corridors on three adjacent ample and regular terraces, measuring 66x33 m. Some wall sections still preserve up to two meters in height and rests of clay plaster. In this case, the principal motivation for building these facilities at this place was probably not related to the number of locals living in the area but to easy access to the Santa Cruz valley by a path following an ample *quebrada* and crossing the narrow mountain ridge separating the two valleys.

6.7.1.3. Rucanas Cabezadas Settlements

At the *cabezadas*, several Rucanas settlements were established which were of much larger size than even the most extended villages from any previous phase. Additionally, numerous medium-size settlements existed, which basically displayed the same layout and building technique. Typically, Rucanas settlements were located on (sometimes artificially leveled) hilltops and the adjacent slopes, which were covered with terraces largely following the natural contour lines. Upon these, circular or oval domestic structures were built with double-face stone murals, often incorporating the retaining wall of the backward terrace. These structures vary in size and building quality from village to village but also within a settlement. Apart from some plazas or open spaces, very little obvious formal architecture can be observed. In addition to the protection by the natural setting, defensive walls or especially high and massive terraces at the access side were common.

There were also completely unprotected villages and hamlets that were established at or close to the valley margins. Most of these settlements were small and consisted of little more than simple construction terraces and ordinary dwellings. Only one qualifies as a population center of some importance: S-1317 at PAP-1107 on the right margin of the Palpa valley at the confluence of three deeply cut-in *quebradas*. Low and broad agricultural terraces can be observed in the interior of the *quebradas*. About 200 round houses were constructed on terraces, arranged around smaller patios or larger walled plazas. Unfortunately, preservation is rather poor due to the constant passage of livestock and reuse of the structures as pens by modern villagers. The sectors separated by the *quebradas* were connected by stairways leading to the *quebrada* floors. No further defensive measures or obvious formal architecture is observable.

With roughly 18 ha, the most extended *cabezadas* settlement was S-234 at PAP-899/773 (Huacramarca), located in the *cabezadas* of Llauta on a hilltop and the adjacent ridge overlooking the Locchas basin. An estimated total of 400 round stone houses were built on construction terraces, arranged around patios, and connected by well-defined paths, some of which still show a stone pavement. Although the dense vegetation does not allow a full appraisal of the settlement structure no remains of structures have been observed which would classify as formal and non-domestic architecture.

This is different in the case of S-1729 at PAP-2001 (Puka Orqo), which is located on the most elevated sections of the ridge that separates the Ocaña and Laramate rivers (the upper tributaries of the Viscas river). Originally, the survey by the Palpa Project stopped at PAP-921 just to the southwest of the modern road which crosses the ridge to connect the two valleys. During a complementing reconnaissance hike in 2011, however, two Rucanas settlements were found on the upper reaches following a narrow uphill mule path. The much larger one is S-1729 which stretched over two hilltops and the

adjacent slopes (Figure 115). The numerous construction terraces contain the usual circular or oval dwellings and, dispersed in between, a considerable number of stone-lined storage pits. Walls are generally double-faced and include stones of very different size but in a casual arrangement. Unfortunately, the preservation of most structures is poor. The site is exposed to the wind blowing out the earthen mortar and in combination with frequent earthquakes this will have caused most walls to collapse. In some sections, a close look is necessary to distinguish the original bases from the surrounding wall fall.

On and close to the hilltops where the terrain is relatively flat, some large walled plazas with adjacent rooms can be observed. The rooms tend to be of rectangular shape and are somewhat ampler than most dwellings. They may have served non-domestic, perhaps administrative, purposes. The special importance of this center is underlined by exceptionally heavy fortifications at its western extreme where the ridge descends towards the confluence of the Laramate and Ocaña rivers. Here the path is almost completely blocked by a high rock which had been converted into a kind of defensive tower or gateway by fortifying its top. The very narrow path passes between the rock and the scarp, and is easy to control. Additionally, access to the western hilltop is blocked by three lines of defensive walls which in some sections still stand up to three meters high.

Relatively close-by – only about 4 km upstream, following the Laramate river – lay S-289 at PAP-958 (Colca Chica) on a high ridge between the valley itself and a deep *quebrada*. It covered at least 12.5 ha. A general feature of S-289, also at its upper reaches, is the direct association of dwelling sectors and agricultural terraces. The ridge does not ascend steadily from south to north but in a stairway fashion: narrow sections and inclined sections alternate with broader and relatively flat areas where the remains of numerous dwellings can be found. These are often grouped around small patios and many have stone lined storage pits. Looted burials can also be observed between the structures. In some cases, the bodies seem to have been placed in abandoned storage pits rather than in tombs originally designed as such. The ridge finally widens, so that the uppermost portion grows broader and the slopes to the east and west are less inclined. Especially the eastern slope is completely covered by well-built agricultural terraces which are divided by walls into vertical sections. At some spots offering a good overview, small semi-circular platforms can be seen, which may have served as observation points from where work on the terraces could be supervised. On the ridge and the uppermost slope stretches the largest dwelling sectors. About 100-120 house ruins were counted here, but the complete settlement including all sectors will have comprised at least 200-250 dwellings.

Apart from the population centers and smaller settlements located in the *quechua* zone and in close association with agricultural terraces, a number of apparent herder villages were established in the *puna*. Though these were quite extended in some cases, they all classify as small settlements or hamlets because they contained only few and small dwellings. The major parts of the respective sites consist of the remains of pens of different sizes. In many cases, these places may only have been inhabited seasonally, as domestic refuse is scarce. An example of a herder village is S-203 at PAP-846 (Pichqa Pukio). The popular *quechua* site name means “Five Springs,” hinting to favorable local conditions as water and pastureland is available all year round. The pens of single-face drystone walls (*pirka*), generally not preserving more than two or three rows, vary in size between 8-100 m in diameter. In between the pens and often directly attached to them, there are the remains of some smaller round or semi-circular dwelling structures. Two of these were partly excavated in 2009 but did not reveal anything more than a few ceramic sherds and a fire place in the center of one hut (Reindel et al. 2008).

6.7.1.4. Cabezadas Settlements Including Inca Architecture

Contrary to the Wari, the Inca were apparently not especially interested in the *cabezadas* as only in one case major Inca installations could be identified. These structures were placed into the probably pre-existing Rucanas settlement S-132 at PAP-788 (Santa María). S-132 was not placed on a ridge or hilltop but on a moderately inclined plateau-like section with a diameter of about 600 m. This area is located at the lower reaches of a slope at the left margin of the Laramate valley (*cabezadas* of Laramate), just below PAP-767 (Cutamalla) (Figure 116d). Access is limited to the northern and southern sides, while scarps reaching upwards or downwards protect the settlement to the east and west. Nevertheless, defense does not seem to have been the principal concern for choosing this location. If it had been, the accessible sides would have been fortified. The fact that the site offers an ample, only moderately inclined terrain suitable for rain-fed cultivation on broad terraces (as long as precipitation suffices) will have been more important. No pre-Hispanic irrigation canals were identified at the upper

parts. The lower parts are presently irrigated and might have been since the Middle Horizon, when a small Wari compound existed some 180 m to the south of the Inca buildings (S-1723).

The Rucanas settlement stretched along the eastern and southeastern extreme of the plateau, just where the terrain begins to ascend. Construction terraces can be observed in the steeper sections. Exceptionally carefully built round houses with double-face stonewalls were erected upon them, many of which are still well preserved. Their diameters vary roughly between 6-9 m, which exceeds the average house size in most other Rucanas settlements (Figure 116a).¹²¹ In several cases, wall niches can be seen. These are typical for Wari and Inca architecture but apparently, they also occur in some Rucanas buildings. Dispersed between the houses, there are at least five large round chullpas with a diameter of about 7-9 m, a roof of stone slabs, and several chambers. Size and quality of these burial structures exceed those of comparable tombs in any other contemporary settlement in the study area.

At the southwestern extreme of S-132, in a slightly elevated position, at least two rectangular structures can be distinguished, now incorporated into a recently built pen. The smaller one measures 5.5 x 5 m and preserves little more than the bases and some rests of the original walls at the corners. The stones were not dressed but carefully chosen, with a preference for those with a more or less cuboid form. The much larger (7x16 m) building 20 m to the west is much better preserved. It has 80 cm wide double-face walls still standing up to four meters high with interlocking cornerstones (Figure 116b).

The lower and flattest parts of the site consist exclusively of agricultural terraces. Some of these show traces of repair as there are patches displaying a different building technique and using smaller stones. This may hint to an original construction predating the Rucanas occupation and to a rehabilitation and reuse after centuries of abandonment. In this context it has to be kept in mind that PAP-788 also contains a sector with apparent Wari architecture (S-1723) just to the south of the Rucanas settlement, though only the bases of a small rectangular complex are preserved. Another Wari settlement with formal architecture, S-1718 at PAP-879 (Tranca), was located close-by. A Wari origin of at least part of the terraces is therefore not only possible but even likely.

Apart from PAP-788, only two *cabezadas* sites already mentioned in Chapter 6.6 – PAP-1105 (S-1742) and PAP-1106 (S-1741) – show remains of rectangular structures with wall niches. The buildings might be of Inca origin, although it is also possible that they date to either the Wari Period or to the colonial era. The buildings are small (3x5 and 4x6 m) and not associated with domestic sectors. Whatever may have been their function at whatever time, they were probably not of outstanding importance.

6.7.2 Settlement Location and Subsistence

During the Middle-Late Ica & Inca phase, the entire study area was re-settled and villages were located at 10-34 hours walking distance from the coast (Figure 110). Settlement distribution clearly shows that both the foothills and the *cabezadas* were densely populated. There nevertheless was a wide unsettled gap between both areas, especially in the Viscas valley (Map 28). This coincides with a markedly different settlement layout: agglutinating angular structures at the foothills and round ones at the *cabezadas*. Although diagnostic sherds found at the surface are largely identical in both regions, a cultural and perhaps even a political border likely ran between them.

Settlers at the foothill based their economy on irrigation agriculture. Due to the abandonment of

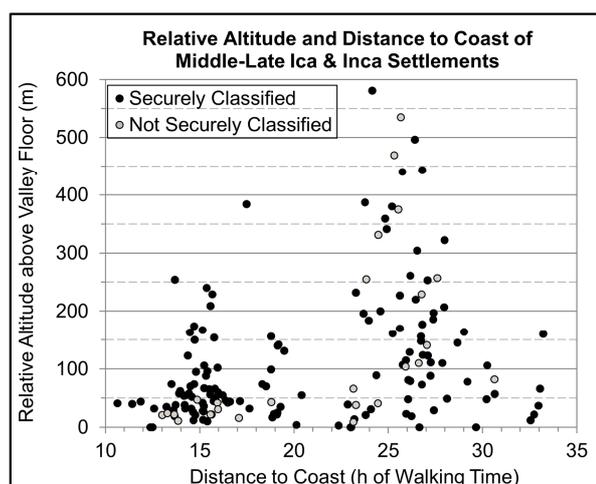


Figure 110: Relative altitude above the valley floors and walking time distance to the coast of Middle-Late Ica & Inca phase settlements. Graphic: VS.

¹²¹ One of the round houses and the larger of the rectangular structures have been laser-scanned in detail by a team of geodesists from ETH Zürich in 2011 (Müller 2011). The resulting 3D models may serve for future studies of the site as they document a state of still relatively good preservation, which may worsen soon.

many fields in the course of the massive population breakdown in the early colonial era, small sections of Ica Period irrigation canals were not overbuilt in later phases and were partially preserved at slopes which are presently not suitable for cultivation. Interestingly, no Nanasca settlements were located along the left margin of the great floodplain. The reason might be that the natural terrain offers few locations that are easily defensible. As most of the larger and more important Nanasca and Rucanas towns and villages were established on hilltops or at places protected by scarps, living in a safe place apparently was a priority. Given the high population level and the favorable climatic conditions, the floodplain can be expected to have been under cultivation. This means that farmers must have been willing to walk up to two hours to reach their parcels of land.

New strategies were developed to maximize cultivation that complemented the traditional method of conducting river water into artificial canals. At the large Nanasca population center of Huayurí in the neighboring Santa Cruz valley (Novoa Bellota 2002:230-231, Kroeber et al. 1998:39, Neudecker 1979, Ubbelohde-Doering 1958), Bertil Mächtle and his team identified a system for water harvesting. By closing a broad *quebrada* with a bund, the sparse precipitation would not run off but filtrate into the sediments where it was protected from evaporation and remained fresh (Mächtle et al. 2009/2012). In the middle section of Quebrada Camajayoc remains of apparent cross-channel terraces were found that were arranged one behind the other (Figure 111). They once blocked the *quebrada*, which today is only a tiny runlet, forcing the water to slow down, spread, and flood the terraces before the excess flowed over the coping of the retaining wall onto the next level. No numeric date indicating the construction period is currently available but such a system only makes sense if sufficient runoff is available. This should have been the case during the late 13th to mid-15th century CE. The bones of camelids found in some LIP foothill settlements, including S-332 at PAP-396 (Chillo, Renneberg 2008), offer strong evidence that highland products were also available to the *yunga* farmers. A flourishing exchange with the *cabezadas* people can therefore be assumed. The same can be stated for the relations with coastal dwellers.



Figure 111: Cross channel terraces of unknown age at the middle reaches of Quebrada Camajayoc, which today is only a minor runlet. Photo: VS.

At the *cabezadas*, an increase in herder settlements in the *puna* and *suni* zones is observable, but compared to the general growth of settlement area and population, the importance of camelid breeding for the overall economy could at best have remained stable. A real boom must have taken place in rain-fed and irrigated terrace cultivation. Though the construction time of terraces is extremely difficult to determine, it seems logical that the areas with the best conditions – less inclination, best soils, and additional water supply by springs – would have been used first. As population grew, more marginal slopes had to be brought under cultivation. Accordingly, the most marginal terraces, where the ratio of effort in construction, maintenance, and cultivation over the expectable harvest was worst, were likely built during a time when conditions concerning the amount and reliability of precipitation were most

favorable, while at the same time population levels peaked. Both was true during the later LIP. Consequently, it is likely that almost all existing terraces were reused and perhaps modified, and that additional ones were constructed wherever possible. These terraces can still be observed at slopes of 30-40° and more, where retaining wall had to be built two meters high to create a cultivable strip of less than 3 m in width (Figure 112).



Figure 112: Abandoned agricultural terraces at a slope of 30-40°. Though they were not dated directly, it is plausible that they were built in such a difficult location only at the time of maximal population pressure which is arguably the Middle-Late Ica phase. Photo: VS.

An interesting feature is the presence of sculptured stones representing terrace systems at a number of sites associated with agricultural terraces. Some of these sites also contain pre-LIP occupations. It is therefore possible that at least some of these stones date to earlier phases. An especially impressive example are the carved rocks at PAP-808 (Lindero) where the Middle Nasca village S-150 existed which was at least partly reused in the Middle-Late Ica phase (S-151). From here, the terraces of PAP-788 (Santa María) on the opposite valley margin are visible (Figure 113). The rocks could have played a role in fertility rituals but do not model the real landscape in realistic proportions.

A site where excellently preserved, irrigated LIP terrace systems can be studied is located just south of the Nasca drainage in the Lomas valley, close to the modern village of Santa Lucia at UTM 549,100 E / 8,341,800 N (2150 m.a.s.l.). In this area, a moderately undulating *pampa* is delimited by two steep *quebradas*. A settlement is located on a fortified hilltop just on the edge of the northern *quebrada*. It consists of numerous round houses at the upper and middle reaches, a large walled plaza at the top, and rectangular compounds at the hillfoot (Figure 117a). Also a number of looted burial structures can be observed. This is the pre-Hispanic village corresponding to the *reducción* Santa Lucía de Azqui mentioned by Luis de Monzón who visited the Lucanas provinces as *corregidor* in 1586. He stated that the village name refers to “good weather, because *azqui* means in the language of the indios good place” (Monzón 1965b



Figure 113: Sculptured rock representing agricultural terraces at PAP-808 (Lindero). From here the terraces of PAP-788 (Santa María) can be observed (background upper right corner). Photo: VS.

[1881]:230).¹²²

Indeed, the area must once have been especially favorable for agriculture. As far as the eye can see, the surrounding *pampa* – now deserts and almost completely devoid of vegetation – is covered by the remains of ancient fields in combination with irrigation canals crossing them in serpentine from top to bottom (Figure 117b). Small *quebradas* traversing the *pampa* were probably used for water harvesting as suggested by the presence of crossing retaining walls which apparently functioned as sediment traps (Figure 117c). These installations were clearly built when significantly more water was available than today. The fields are surrounded by stonewalls which may have protected them from browsing or which just served to mark possessions. Just outside the settlement, some rocks cropping out of the surface were carved to represent terraces (Figure 117d), and in this case the LIP origin of this kind of sculptured stones is almost certain. This highly interesting site surely deserves further studies.

6.7.3 Hierarchy and Defensive Measures

LIP settlements both at the foothills (Nanasca) and at the *cabezadas* (Rucanas) clearly tended to be located in elevated locations high above the valley floors (Figure 114). Although such positions, often far away from a water source, may have been uncomfortable for the inhabitants, they offered some natural protection. In combination with the numerous examples of defensive walls and sling stone deposits, this fact points to frequent violent conflicts. The concentration of population – and hence of potential fighters – in large towns also strengthened defenses.

Many of these extended settlements classify as simple and some even as local centers. This means a substantial shift with regard to the shares of the different status classes in the total settlement area. The area of common settlements only made up 30.1% of the total settlement area, which is the lowest value of all phases. Numerous villages were so large that they were classified as simple centers (32.8%), although many contained little architecture that could qualify as special or formal. There were others still accounting for 28.7% of the overall area which were classified as local centers because these did contain such features, at least in a rudimentary form. Additionally, during the Late Horizon, Inca administrative facilities were constructed in either existing towns or as isolated complexes. These foreign administrative centers and posts comprised another 7.5% of the total settlement area. Despite the establishment of seasonal herder villages in the *puna*, non-permanent villages account for less than 1% of the overall LIP settlement area (Figure 118).

With regards to the political organization, a distinction has to be made between the situation before and after the incorporation of the study area into the Inca Empire. This is quite difficult, as many LIP settlements can be expected to have continued in use more or less unchanged until the Spanish Conquest. Before Inca rule, the clear spatial separation but also the markedly distinct layouts of foothill and *cabezadas* settlements offer evidence against the existence of a unified polity or a uniform cultural group. Fortifications, sling stone deposits, and the very choice of defensible locations for the establishment of important settlements point to frequent violent conflicts. On the other hand, Inca style ceramics can be found in both areas, though decorated wares are less frequent in the highlands. Furthermore, highland products such as camelids and tuber crops occur in foothill settlements, suggesting a close socio-economic relationship between the inhabitants of both zones. It is very possible that the principal threat emanated from groups outside the study area, perhaps from those occupying the neighboring valleys or the eastern *quechua* across the *puna* while the mutual economic dependence assured largely peaceful relations between *cabezadas* and foothill dwellers in the same valley.

The political relations within the foothills and the *cabezadas* are also difficult to interpret. At the foothills, four towns have been classified as local centers because they are exceptionally large and contain remains of some special non-domestic architecture. It seems nevertheless likely that these constituted two pairs of related settlements: S-469 (Pinchango) and S-448 (Las Colcas) on the one hand, and S-1114 (Cerro Mollake) and S-873 on the other. In both cases a larger, well-protected principal center lay close to a relatively easily accessible smaller center where some evidence of surplus storage and processing is observable. If any settlement ever assumed any kind of hegemony at the foothills, S-1114 and S-469 are the most likely candidates. There are a number of simple centers which may have been either independent or subordinate to one of the two local center pairs but which were too small or too simple to be likely candidates for local centers themselves. Even

¹²² My translation. Original reads: “[...] temple bueno, que *azqui* quiere decir en lengua de los indios buen sitio [...]”

before it was enlarged during Inca rule, S-312 apparently was another settlement of special importance and perhaps comparable in status to S-469 and S-1114. It would have to be seen in context with other Nanasca settlements along the Ingenio and Río Grande rivers south of the study area to better understand its status and function. This will be a task for future studies.

At the *cabezadas*, at least three settlements – S-1739 (Puka Orqo), S-234 (Huacramarca), and S-289 (Colca Chico) – may be classified as local centers. S-132 (Santa María) is another candidate but in this case the possibility cannot be disregarded that the majority of the structures still visible today were not built before the Late Horizon. However, none of these settlements constitute a clear qualitative leap. They exceed most simple centers in size and, especially in case of S-132, in architectural quality, but the differences are slight. Only few structures seem to have served administrative functions. In sum, a clear formal hierarchy is not reflected in the settlement pattern but a loose confederation of the principal Rucanas towns is very possible.

6.7.4 Major Inter-Phase Developments

After the study area had largely been abandoned at the end of the Middle Wari phase, no new settlements were established for more than 300 years. A massive and rapid re-colonization must have taken place in the 12th and 13th centuries. This phenomenon cannot be explained by natural population growth but only by large-scale immigration. When the Inca arrived in the 15th century, the region had probably reached its highest population density.

As always, interpreting settlement pattern maps is problematic when lumping all settlements of a long phase. The case of the LIP, however, is special in some respects. First, due to a hiatus of several centuries, it is not possible to distinguish the earliest settlements by looking for occupation continuities from the previous phase. Second, no information is available on how many and which settlements continued to exist into the early colonial era. As a consequence, a reconstruction of population development by comparing the situation at phase transitions does not work in this case.

Another particularity may relativize the contemporaneity problem (see Chapter 5.3): many settlements were exceptionally large and solidly built at carefully chosen locations. Given the considerable effort in establishing them, it is not likely that they were abandoned so easily. Contrary to simple *quincha* hut villages, most solid stone houses would have remained occupied for centuries, and thus it is probable that the majority of the settlements were in use simultaneously at the height of the LIP between the 13th and 15th century. On the other hand, a significant difference in average occupation span of LIP settlements compared to that of earlier phases would mean that comparing index values was not valid, because this approach requires an approximately equal average occupation span for all considered phases (see Chapter 5.3.1).

During the Late Ica & Inca phase, Inca administration may have triggered some major population shifts by establishing new settlements, especially S-1048 (Pueblo Nuevo), and expanding existing ones, but perhaps also by forcing or encouraging the abandonment of others. The Inca governors enforced a kind of *Pax Incaica*, quelling internal conflicts and preventing military threats from neighboring regions (which had also been brought under Inca rule). There was thus no need any more to accept the inconveniences of dwelling on steep slopes or mountain peaks for feeling safer. It is therefore possible that the centers in less defensive positions such as S-132 (Santa María) as well as the easily accessible sectors of large settlements with a fortified principal core, such as S-469, S-1114, and S-312 were established *after* the arrival of the Incas and thus represent the Late Ica & Inca phase rather than the Middle Ica phase. This hypothesis remains to be thoroughly tested.



Figure 114: PAP-114 (Pinchango Alto), one of the three major sites included in the Nanasca settlement S-469, was surveyed in 2004 by a team of geodesists from ETH Zürich (Eisenbeiss 2009). The survey plan illustrates well the pattern of angular agglutinated structures typical for foothill settlements of this phase. Inlay photo at upper left: one of the better preserved rooms with double-face stonewalls. Inlay photo at lower right: the site seen from the opposite ridge, looking in southwestern direction. Note the natural protection by steep scarps as well as the system of multiple massive walls controlling access to the settlement (in the foreground). Orthophoto: Henri Eisenbeiss and students, survey plan: M. Zwicker, inlay photos: VS.

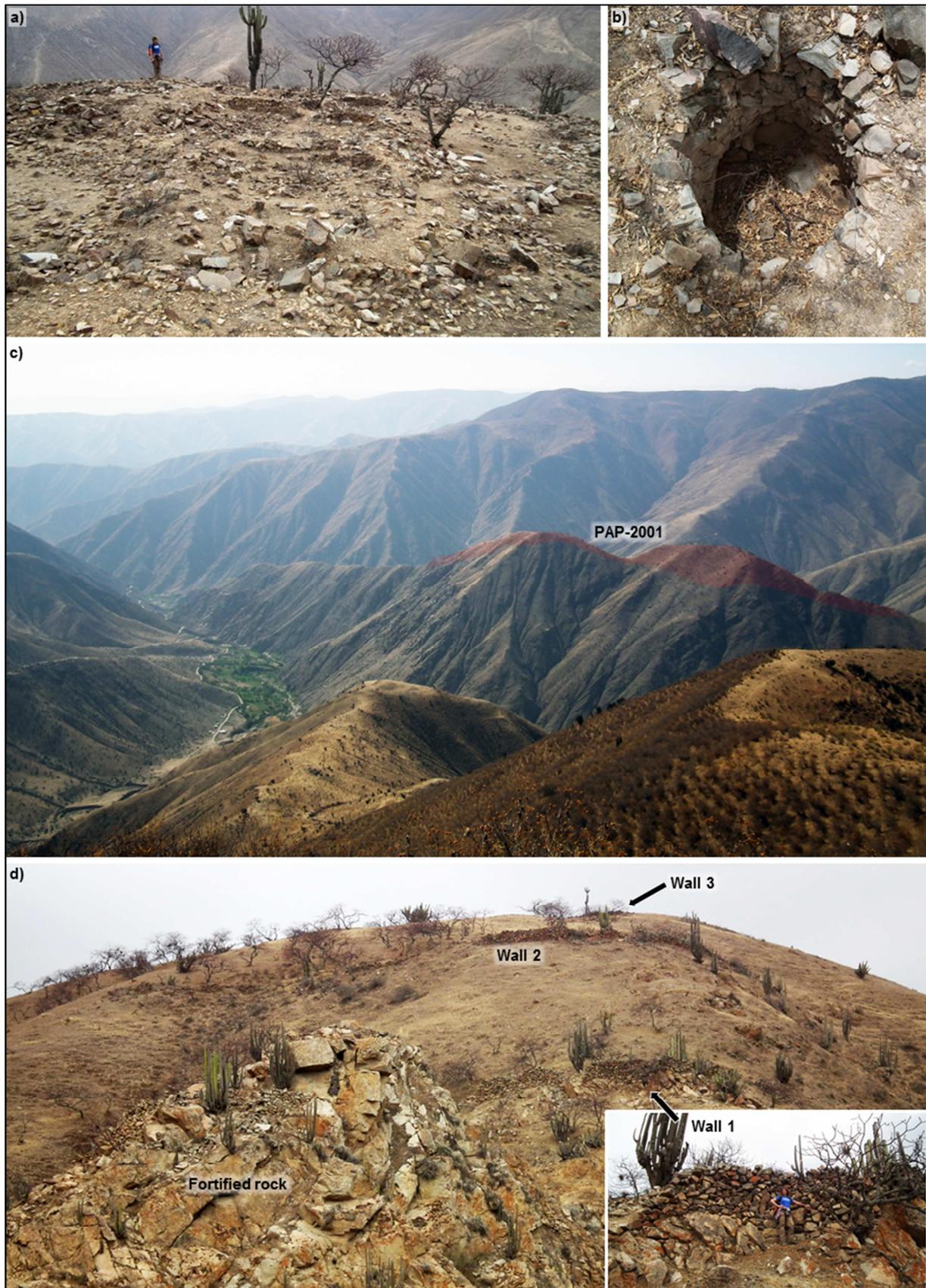


Figure 115: S-1739 at PAP-2001. a) The western hilltop which contains some probably nondomestic structures, b) one of many stone-lined storage pits that can be found scattered all over the site, c) general view of the Puka Orqo mountain, towering up to 400 m above the valley floor, d) the western end of the settlement protected by a cascade of three massive defensive walls and a fortified rock controlling the narrow path leading towards the hilltop. Photos: VS.

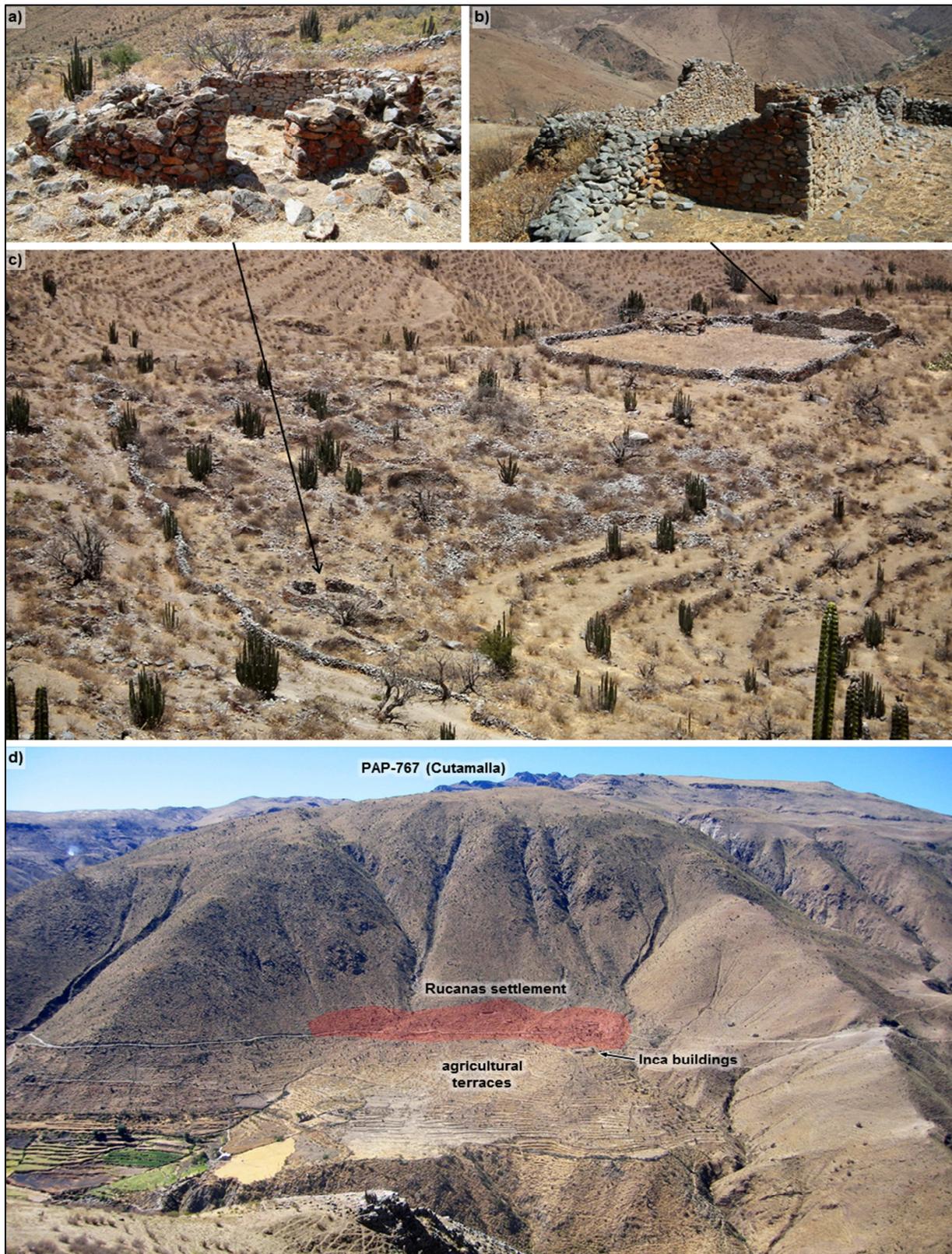


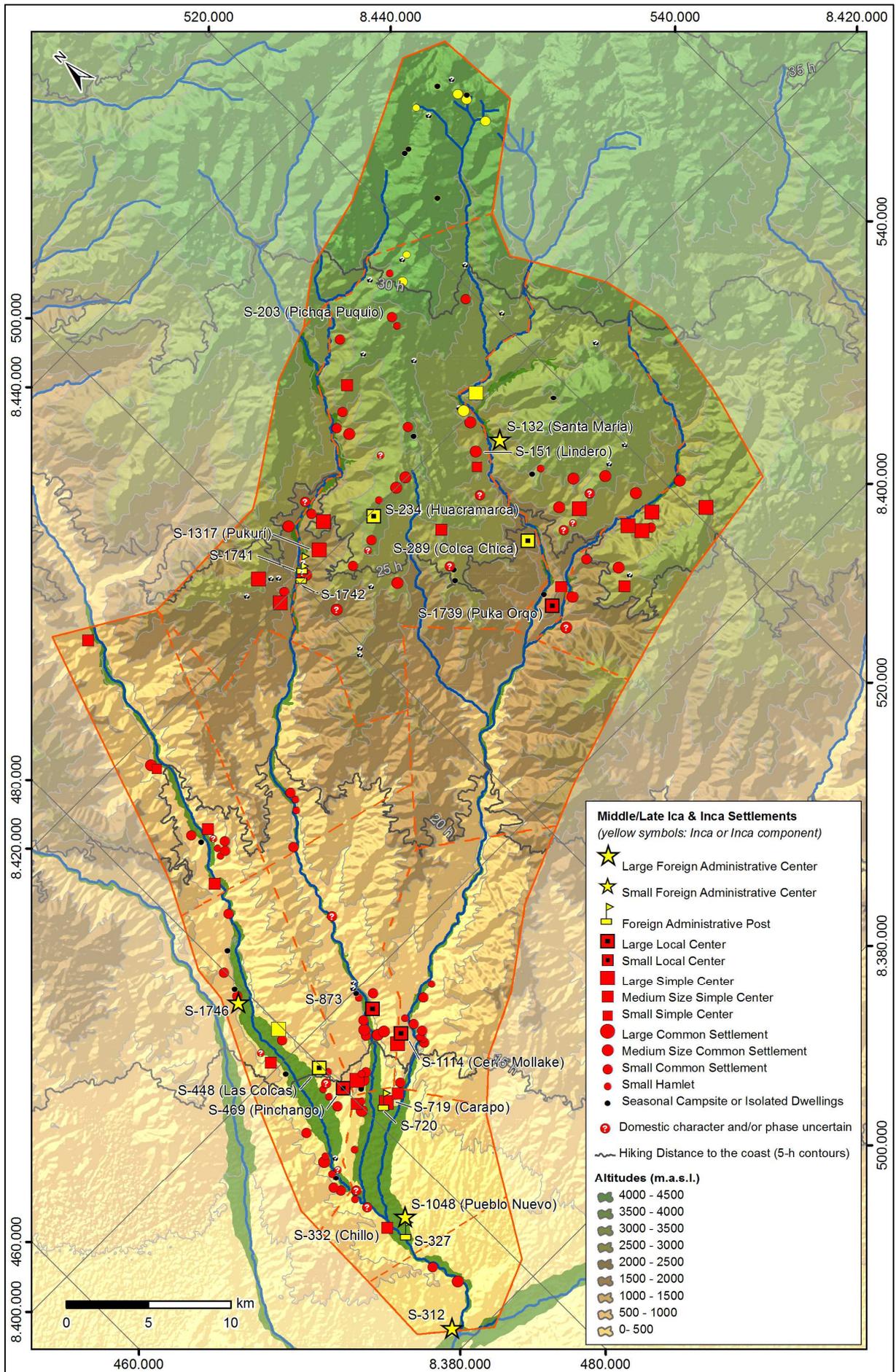
Figure 116: S-132 at PAP-788 (Santa María): a) A well preserved round house (also see Figure 22h) built with a double-face stonewall and conserving about 1.8 m in height. Note the well-defined entrance. b) The bigger rectangular structure of probable Inca origin. The walls still stand up to 4 m high. The adjacent walls have been piled up in recent times to create a pen for livestock. c) Overview over the southwestern section of the settlement where the two structures are located. d) General view (looking east) of PAP-788 revealing the considerable extent of the agricultural terraces. The green fields at the lower left are irrigated and still under cultivation while the abandoned upper terraces depend on rainfall which today is insufficient in most years. Photos: VS.



Figure 117: The Rucanas settlement of Azqui and the extended surrounding terraces, which were once irrigated. The site is located close to modern-day Santa Lucía, south of the Nasca drainage. a) The hilltop which is covered by the remains of round houses on its middle and upper reaches. In the foreground a walled field can be seen. b) View from the hilltop over the surrounding pampa which is almost completely covered by ancient fields. c) Cross-channel terraces in a small quebrada, probably built to create sediment traps. d) A carved rock right between the fields representing canals and terraces. Photos a), b), and c): VS. Photo d): Benedikt Gräfinhold.

Middle-Late Ica & Inca Settlements			
Numbers in brackets: result of calculation excluding settlements with uncertain classification concerning the domestic character and/or the phase assignation			
Phase start		Phase end	Phase length
Likely date: 1180 CE		1532 CE	Likely length: 352 years
Earliest possible date: 1130 CE		1532 CE	Shortest possible length: 282 years
Latest possible date: 1250 CE		1532 CE	Longest possible length: 402 years
Settlement number and area			
	<i>Number</i>	<i>Area</i>	<i>Avg area</i>
Total:	188 (147)	394.88 ha (381.16 ha)	2.10 ha (2.59 ha)
<i>b-type settlements (minimum extent):</i>	0 (0)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
<i>At phase start (types a + bS):</i>	0 (0)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
<i>At phase end (types bE + c):</i>	0 (0)	0.00 ha (0.00 ha)	0.00 ha (0.00 ha)
<i>Established after phase start and abandoned before phase end (type d):</i>	188 (147)	394.16 ha (366.02 ha)	2.10 ha (2.49 ha)
Growth and dislocation			
Area net growth:	0.00 ha (0.00 ha)	0.0 % (0.0 %)	
Dislocated area:	0.00 ha (0.00 ha)	0.0 % (0.0 %)	
	<i>Likely phase length</i>	<i>Shortest phase length</i>	<i>Longest phase length</i>
Area growth per year:	0.00 % (0.00 %)	0.00 % (0.00 %)	0.00 % (0.00 %)
Population Index:	1.12 (1.08)	1.4 (1.35)	0.98 (0.95)
Status classes			
Number of settlements		Settlement area	
Non-permanent settlements:	24 (8) 12.8 % (5.4 %)	1.67 ha (0.51 ha)	0.4 % (0.1 %)
Common settlements:	122 (99) 64.9 % (67.3 %)	118.79 ha (106.40 ha)	30.1 % (27.9 %)
Simple centers:	27 (27) 14.4 % (18.4 %)	129.65 ha (129.65 ha)	32.8 % (34 %)
Local centers:	7 (7) 3.7 % (4.8 %)	113.41 ha (113.41 ha)	28.7 % (29.8 %)
Administrative posts:	4 (2) 2.1 % (1.4 %)	1.88 ha (1.71 ha)	0.5 % (0.4 %)
Administrative centers:	4 (4) 2.1 % (2.7 %)	29.48 ha (29.48 ha)	7.5 % (7.7 %)
Population size classes			
Number of settlements		Settlement area	
Isolated dwellings:	40 (17) 21.3 % (11.6 %)	3.19 ha (1.61 ha)	0.8 % 0.4 %
Small hamlets:	33 (26) 17.6 % (17.7 %)	9.42 ha (7.15 ha)	2.4 % 1.9 %
Small settlements:	53 (44) 28.2 % (29.9 %)	44.21 ha (36.94 ha)	11.2 % 9.7 %
Major settlements:	39 (37) 20.7 % (25.2 %)	111.43 ha (108.84 ha)	28.2 % 28.6 %
Population centers:	23 (23) 12.2 % (15.6 %)	226.62 ha (226.62 ha)	57.4 % 59.5 %

Figure 118: Basic data of Middle-Late Ica & Inca settlements. Graphic: VS.



Map 28: All settlements of the Middle-Late Ica & Inca phase. Map: VS.

7 Discussion: Settlement, Migration, and Climate Change

The results presented in Chapter 6 paint a picture of highly dynamic cultural development and frequently changing settlement behavior in the northern Río Grande de Nasca drainage (NGD) between 1500 BCE-1532 CE. Likewise, records from various geoarchives from the study area itself combined with others from remote regions reveal strong evidence for notable fluctuations in climate regimes (Chapter 2.2.3). Causal relations between major shifts in climate and breaks in cultural development have been proposed in many studies on ancient Central Andean societies, but these theses can rarely be proven true unequivocally. The intense multi-disciplinary research in the study area over the past 15 years offers the possibility to address the problem for the particular case of the NGD by systematically evaluating a vast amount of data. Were some major changes in settlement behavior in the NGD caused by climate change? If yes, which ones?

In the following, settlement patterns will be discussed in a wider geographic context with a special focus on cultural change, population development, and migration.¹²³ While doing so, the foothills and the *cabezadas* will be considered individually, due to the cultural differences between both areas observable in several phases. By contrasting the results with the reconstructed climate history, conclusions can be drawn about if and when a causal link existed between climate change and settlement behavior.

For the following discussion of long-term processes and phenomena some phases and sub-phases defined in Chapter 5.2.2 during which a more or less smooth development can be postulated were joined. The resulting six chronological blocks will each be treated in a separate sub-chapter. These are preceded by another two sections discussing two aspects of importance for the entire cultural sequence: the apparent antagonism between foothills and *cabezadas* dwellers and the impact of migration on population development.

7.1 Foothills and *Cabezadas* Dwellers

Throughout the 3000 years of settlement history regarded in this study, there has always been a distinction between the foothills settlements and those located at the *cabezadas*. In order to explain this important point more clearly, starting with the last phase before the Spanish Conquest is best. Since some early colonial documents contain direct or indirect information on the social and political situation during the Late Intermediate Period and the Late Horizon, it is not necessary to rely on archaeological data alone. Such ethnohistoric sources testify that the study area was indeed inhabited by two culturally distinct and politically independent groups.

The Nanasca population at the foothills must have been substantial, though little else is known. These people were culturally closely related to the contemporaneous inhabitants of the Ica valley, although there is no evidence for a political subordination to the Ica polity ruled from Tacaraca. Large quantities of fineware sherds of Ica-style pottery and its local derivatives can be found scattered across the ruins. The Nanasca buried their dead in subterranean pits, built irregularly agglutinating dwellings of angular shape, fortified their more important towns with walls and ditches, and prepared for surprise attacks by piling up sling stones at elevated positions. Settlement patterns suggest a loose confederation of major centers and their surrounding lower-ranking villages (cf. Chapters 3.2.4.4 and 6.7).

Colonial-era documents also record that the *cabezadas* were settled by the Rucanas Laramati who were ethnically and culturally related to the Rucanas Andamarca living across the *puna* in the area around the present-day city of Andamarca (cf. Abraham 2010, Mölders 2010, Schreiber 1993). These people lived in much the same way as their Andamarca relatives. They built round houses, (re-)buried some of their dead in *chullpas*, and practiced terrace-farming and camelid herding. They, too, may have formed a loose confederacy without a central capital. In case of the Rucanas it is known for sure that they were ethnically, culturally, and politically distinct from the foothill people although they also used some Ica-style pottery, at least in addition to local plain wares and perhaps some so-far unrecognized pieces from Andamarca.

¹²³ The location of sites and places mentioned in the text is shown on Map 5, Map 6, and Map 7.

When the *corregidor* Luis de Monzón compiled information on the *reducciones* of the Lucanas province in 1586, he was told that in between the Rucanas Laramati settlements there was also one attributed to Rucanas Andamarca. This exception is the village of Uraguaci near present-day Tambo Quemado in the *cabezadas* of the SGD:

[...] [T]here is a small village of indios from the mentioned district of Apcara which is called *Pueblo Quemado*.

[...]

In the days of yore, *San Cristóbal Pueblo Quemado* was called *Uraguaci* which means houses located downhill, and during the unrests that occurred in these lands [the civil war among the *conquistadores*], the Spanish burned this village, and until today it is called *Pueblo Quemado* [the Burned Village]. (Monzón 1965a [1881]:240-241 (Chapters 12 and 13), italics original)¹²⁴

Interestingly, Apcara, the place of origin of the people dwelling in Uraguaci, was the capital of the Andamarca region. Accordingly Uraguaci was inhabited by settlers from across the *puna*. Schreiber visited the site in 1986 and found that “[a]bout 10 percent of the surface sherds are styles identified in the Carhuarazo valley [in the Andamarca region] – styles dating also to the LIP” (Schreiber 1992:127). Accordingly, not only the Rucanas Laramati but even those settlers known for sure to have come from Andamarca predominantly used local ceramics (about 90%) while pots of Andamarca styles only made up for a small portion (10%). This observation shows that sherds can definitely not be regarded as a reliable cultural or ethnic marker during the LIP and probably not during earlier periods either. In the study area, diagnostic fineware of all phases is much less frequent at the *cabezadas* than at the foothills, but the sherds that can be found are largely identical in both regions.

Apart from the LIP, there were two further time sections during which the *cabezadas* were densely populated by people whose settlements clearly differed from those at the foothills, although the associated diagnostic ceramic sherds are very similar. The first section spans 150-300 years, beginning in the late Middle Paracas phase and lasting until the start of the Initial Nasca phase. The second was a comparatively short but intense intermezzo of probably less than a hundred years during the Middle Nasca phase. In both cases no written records are available, but the archaeological evidence with respect to architecture is very similar to that for the LIP. Constructions at the *cabezadas* tended to be of round shape while those at the foothills were mostly angular. Possibly, the situations are, to a certain degree, comparable in general and the *cabezadas* settlers of the Middle-Late Paracas and Middle Nasca phases also belonged to a different culture group than their respective foothill neighbors.

Katharina Schreiber (1988) observed round dwelling structures built of stone at 27 sites in the Aja and Tierras Blancas valleys (SGD) at altitudes as low as 700 m.a.s.l. Some of these are associated with surface material from the Early Nasca phase, though most seem to date later. One site, Marcaya, had later been excavated by Kevin Vaughn (2000/2009) who could confidently date it to the transition from Early to Middle Nasca. Apparently, this type of settlement occurred earlier and at lower altitudes in the SGD than it did in the NGD. Unfortunately, the limited published information on the results of Schreiber’s surveys does not allow a more profound intra-drainage comparison.

During the LIP, there most likely existed a close economic relation between foothills and *cabezadas* groups. The goods offered by the lowlanders, probably in exchange for camelids, wool, dried meat, tubers and pseudo-cereals, apparently included fancy pots. Although the highlanders also fortified some settlements, chose defensive locations, and maintained some distance to the foothill settlers (Map 28) a permanent conflict between the two groups is unlikely, given the mutual economic dependence. Raiding parties from the northern valleys were possibly a greater concern for both, as can be deduced from Cieza’s remark that the Chinchas “did great harm to the Soras and Lucanas [...]” (2005 [1553]:202 (Chapter LXXIV)).¹²⁵ Nevertheless, small-scale inner-group conflicts were probably

¹²⁴ My translation. Original reads: “[...] está un pueblo pequeño de indios de este dicho repartimiento de Apcara, que se dice Pueblo Quemado.

[...]

San Cristóbal Pueblo Quemado se solía decir antiguamente *Uraguaci*, que quiere decir casas que están en lo bajo, y en los alborotos que hubo en esta tierra, quemaron los españoles aquel pueblo y hasta hoy se llama *Pueblo Quemado*.”

The original Quechua name was probably (*H*)*urin Wasi*. (*H*)*urin* means *down* or *below* and *wasi* means *house* or *home*. However, (*h*)*urin* does not necessarily refer to a geographic location because (*h*)*urin* and (*h*)*anan* (*up* or *above*) were frequently used to distinguish the two moieties many Andean societies, including the Inca, were composed of. Accordingly, the name of the village may simply indicate that its inhabitants belonged to the (*h*)*urin* moiety of the Rucanas Andamarca people and not that their houses were located at a low altitude.

¹²⁵ Garcilaso de la Vega opposes, saying that the stories of the Chinchas who claim to have raided as far as to Lake Titicaca are not true (1941 [1609]:168-170 (6th book, Chapter XIX)).

not uncommon, either. Monzón's informants told him about the Rucanas that "before the Incas ruled these lands, they brought war and conflict upon each other about cultivable land and pasture for their livestock [...], and that after the Inca subdued them, they fought no more wars against each other [...]" (2005 [1553]:232 (Chapter XV)).¹²⁶ Signs of conflict are also clearly visible in the archaeological record of the Late Paracas phase and, to a lesser degree, of the Middle Paracas and Initial Nasca phases.

There is nevertheless evidence for close economic relations between foothills and *cabezadas* groups since products originating from one zone were found at sites located in the other (e.g., camelids at Jauranga and coastal ceramics at Cutamalla). Finds proving the exchange of goods were also documented in Middle Nasca contexts. For this phase only few traces of defensive measures were identified. Although further evidence (especially from aDNA analyses) is needed to clarify whether foothills and *cabezadas* groups of the Late Paracas and Middle Nasca phases were of different ethnic origin, the archaeological picture seems to suggest that this was the case.

7.2 Population Development and Migration

The challenging question of population development is directly related to the foothills-*cabezadas* duality. Figure 119 displays the changes in total settlement area following the approach elucidated in Chapter 5.3.2. Since settlement area is regarded as a proxy for population, the curve shows that population levels oscillated significantly.

Settlement patterns were very different between foothills and *cabezadas* during most phases, however, and population levels also differed. For this reason, diagrams have been produced for each of the two areas, in order to show similar and opposing trends (Figure 120). While the details will be discussed later on, marked differences between foothills and *cabezadas* become apparent already at first sight. In several phases, even completely inverse processes are observable. For example, between Late Paracas and Initial Nasca, population levels at the foothills rose dramatically while the formerly densely settled *cabezadas* were gradually abandoned. In turn, during the Early-Middle Wari phase, the last foothills settlements were given up while new centers emerged at the *cabezadas*.

At first glance, it might be tempting to assume a simple population shift within the study area. This would mean that the same people moved up or down according to the most favorable living conditions which could sometimes be found at the *cabezadas* and sometimes at the foothills, depending on climate regime and political situation. Alternatively, highlanders may have come from and returned to other highland regions while lowlanders exchanged population with neighboring coastal valleys. Given the general cultural differences between both groups and their specialization in different types of economic activities (irrigation farming vs. rain-fed terrace farming plus camelid herding), such a scenario is surely worth being considered seriously.

At times when population trends were similar in both areas, for example during the Middle Nasca and Middle-Late Ica & Inca phases, super-regional migration movements are obvious. Since in these two cases the massive population growth probably occurred within a few decades, it is not explicable by reproduction alone. Due to this fact, immigration from outside the study area must have taken place at a major scale. Likewise, for times of general population decline, for example during Late Nasca, there is no evidence for mass mortality. Apparently, most people did not die before they reproduced but simply moved away.

Although it is important to consider migration to and from neighboring regions when discussing population trends, this undertaking is unfortunately hampered by the paucity and patchiness of published archaeological data. In many valleys of the South Coast, but especially in wide areas of the Central Highlands, research has so far been limited to a few cultures and the periods during which they flourished, or to individual sites of special interest. In other zones, either no archaeological work was carried out at all, or the results of some small-scale projects can only be found in unpublished field reports and theses unavailable to the general public. Many of the statements about population movements made in the following subchapters are hence often vague or hypothetical.

The most detailed information for migration is available for the LIP and the Late Horizon thanks to colonial-era written sources complementing the archaeological data. During the LIP, the study area

¹²⁶ My translation. Original reads: "[...] antes que los Ingas señoreasen esta tierra, traían guerra y diferencias los unos con los otros sobre las tierras de sementeras y pastos de sus ganados [...], y que después que el Inga los sujetó, no tuvieron guerra entre sí [...]."

was resettled very quickly by large numbers of people who must have immigrated from elsewhere. The LIP seems to have been a time of major migration movements throughout the Central Andes. Besides increasing archaeological evidence in some regions, early chroniclers wrote down oral traditions of several people, including the Incas, telling of mythical ancestors who originated from elsewhere.

In case of the Incas, for example, a myth states that the first king parted with his entourage from a cave south of Cusco (cf. Urton 1990). The party then traveled through the lands looking for the most fertile soils. When they came to Cusco, they had reached the perfect place, so they subdued or expelled the locals and established their capital. Though there are many different and sometimes contradicting versions of this tale, Lake Titicaca is often mentioned as the place of origin. Recently, Gordon McEwan (2006:57-68) found archaeological evidence at the site of Chokepukio, south of Cusco, which actually seems to support the presence of people from the northern Titicaca region in the area since approximately 1100 CE. In many other cases as well, origin myths of LIP societies telling of migration may contain a true core and a shadowy distant memory of actual events or longer processes.

It cannot be ruled out that the situation at the beginning of the LIP was unique regarding the factors which may have triggered large-scale population movements, especially with regard to the preceding collapse of the Wari Empire. Nevertheless, displacements of entire peoples are likely to have occurred in the Central Andes throughout prehistory, although the scale and the causes of such movements may have been diverse. In the following, the developments during individual periods will be discussed in detail.

7.3 Beginning Initial Period to the Early Middle Paracas Phase (1500 – 450 BCE)

The first section comprising the Initial Period, the Early Paracas phase, and the beginning of the Middle Paracas phase is characterized by a relatively smooth development of culture in general and settlement patterns in particular. Even though the archaeological evidence may be especially fragmentary due to preservation issues, population seems to have grown slowly, and there are no indicators of major short-term, inter-phase deviations from this general trend suggesting major migration movements. Two areas seem to have been especially favored for establishing settlements: the middle valleys and the transitions between the upper valleys and the *cabezadas*. Architecturally, however, the villages in both zones are clearly different, comparable to the *cabezadas*-foothills contrast in later phases: angular, agglutinated rooms in the middle valleys and round or semi-circular structures set against terrace walls further upstream. Accordingly, already during the Initial Period, the population of the study area might not have been culturally uniform, although foothills and upper valley groups seem to have used the same kind of pottery.

Hypothetically, the upper valley settlements could have been colonies of highland societies who had their home territories outside the study area, perhaps somewhere east of the water divide. The following points might support this theory:

- The first settlements concentrated in the Collanco area where large sections of the moderate slopes are covered with simple and possibly very old agricultural terraces while the valley floors proper are very narrow. A few kilometers further upstream, the valley floor is much broader and, if cleared, suitable for irrigation farming, but no remains of early villages have been found there. Perhaps the settlers were familiar with rain-fed terraces but not with valley floor irrigation.
- The villages were placed at an altitude at which some *yunga* crops unavailable in the highlands can still be grown. Accordingly, the colonists could have complemented the production of their home communities. Nevertheless, the choice of the location seems to have followed the principle “as low as necessary and as close to the highlands as possible.” In turn, settlements might not have been established at the *cabezadas*, because the resources available there were largely identical to those across the *puna* and hence not complementary. Colonies at those altitudes would only have made sense for the provision of an excess population from the suspected home territory, but in these early periods, population pressure is not a likely scenario as population levels were still relatively low in most regions.

There are no signs of conflict anywhere in the study area prior to the Middle Paracas phase. Middle and upper valley settlers seem to have coexisted peacefully. Since both groups profited from exchange relations providing access to goods unavailable in their respective territories, this is not surprising. Furthermore, the low population levels made competition for resources unnecessary because these should still have sufficed for all inhabitants of the study area. The archaeological evidence does not suggest any formal political structure beyond the village level, even though at least the directly contiguous villages in the Collanco area may have formed a single community.

The situation may have been different in the northern South Coast valleys. Though little data is available for the IP, there is evidence that during Early Paracas, a strong cultural influence from the north, associated with the Chavín style, was felt throughout the South Coast. At the temple site of Cerillos in the Ica valley (Wallace 1962) Jeffrey Splitstoser et al. (2009) found a variety of exotic goods, suggesting long-distant trade relations and cultural ties. In the Ica valley the Early Paracas society had possibly already developed an advanced degree of social complexity and differentiation and perhaps even a valley-wide political organization. Similar evidence is not observable in the study area, but the diffusion of the “Chavín” style and the concepts related to it into the Río Grande drainage may well have been mediated by Cerillos and perhaps other, undiscovered temple sites in the northern valleys. The Río Grande drainage would thus have been influenced, but not formally controlled by groups inhabiting the Ica valley.

Climate Impacts

As outlined in Chapter 2.2.3, the climate around Palpa during most of the Initial Period probably oscillated between hyper-arid and arid. Only by 1000 CE, conditions changed to near semi-arid. Aridity increased again after 650 BCE and precipitation and river discharge became more variable. During this early era, when population levels were still low, it is unlikely that climate conditions limited the agricultural potential to a degree that would have seriously threatened food supply. At the foothills, the accumulation of fine-grained sediments at the valley floors suggests that irrigation was possible during the whole time span (Hesse 2008), at least at a small scale. It is not clear, however, whether the water supply would theoretically have sufficed to extend the irrigated area if population levels had been higher or if local farmers had not cleared additional sections because the river discharge was too low or unreliable to irrigate more land.

Most of the agricultural terraces in the Collanco area are clearly linked to the Paracas settlements, but possibly, some of them were already constructed by the inhabitants of the IP villages at the same place. These terraces at an altitude of roughly 1600 m.a.s.l. were probably rain-fed. Under the near semi-arid conditions arguably prevailing between 1000 and 650 BCE (with the exception of the early 9th century BCE) the Collanco area would have been located well within the range of rain-fed agriculture, but under the preceding very variable and, by tendency, much drier climate regime it would not have received sufficient rainfall in most years. Accordingly, the area was probably not occupied before the end of the IP (after approximately 1000 BCE) because it is unlikely that settlements were established without need in a risky area in terms of precipitation amounts while there would have been enough uncultivated land available upstream. Under the variable arid to near-hyper-arid conditions arguably prevailing during the second half of Early Paracas and during most of the Middle Paracas phase, however, Collanco would have been located close to the lower altitudinal limit for this production strategy where the risk of occasional droughts is high, especially if climate is very unstable. Continuing excavations in the area will hopefully clarify, whether domestic occupation was continuous or if there is evidence for major interruptions that could be linked to unfavorable climate.

7.4 Late Middle Paracas Phase to the Earlier Initial Nasca Phase (450 – 100 BCE)

Towards the end of the Middle Paracas phase, “Chavín” influence gradually decreased while conflict increased and political integration advanced. Substantial population growth was accompanied by notable changes in settlement behavior (Massey 1986/1991, Menzel 1971, Peters 1997, Tinteroff Gil 2008). After several centuries, this lasting process of cultural change finally gave birth to the Nasca culture. The Paracas-Nasca transition was potentially influenced by several, partly subsequent and

partly parallel, events and processes, be they of cultural, political or climatic character. In the study area, the massive settlement of the *cabezadas* is an especially striking phenomenon. The newly established villages were not only located in spatial proximity to the upper valley clusters but also show a similar architecture. Namely, flower structures were not only documented at numerous highland sites but also at Collanco in the uppermost Palpa valley.¹²⁷ In contrast, there are clear differences between *cabezadas*/upper valley settlements and those located at the foothills, especially at Jauranga (PAP-150). The architectural differences but also the sheer number of newly founded *cabezadas* villages do certainly not support a scenario of colonists moving from the valley floors to the highlands.

An alternative explanation is immigration from outside the study area. Newcomers may have been culturally, ethnically, or politically related to the upper valley dwellers but probably not to the foothills group. They seem to have been familiar with the *cabezadas* environment and knew how to use these lands efficiently. Many of the simpler rain-fed terraces probably date back to this time and the association of some Middle and Late Paracas highland settlements with pens, e.g., Cabracancha (S-141), point to the introduction of modest-scale camelid herding. The homeland of the new settlers could have been located either in the *cabezadas* of the neighboring drainages of the South Coast or right across the *puna* in the eastern *suni/quechua* region. Regrettably, almost no research with focus on the early phases has taken place in these areas, and therefore a direct comparison of material culture is currently not possible.

By the end of Late Paracas, settlement density at the *cabezadas* began to decrease again while at the same time many new villages were established at the foothills. The initial impression may be that the highlanders simply moved to the valley floors, but then the newly founded foothill settlements should show close architectural and conceptual similarities to those abandoned at the *cabezadas*. This is not the case. As before, foothill villages were still clearly different architecturally. None had flower structures and houses were predominantly of rounded-rectangular shape, but never circular. If the *cabezadas* people did not move to the foothills, it remains to be explained where they went. Most probably, they would have returned to the region they had come from about two or three centuries earlier. In this case, a population rise could be expected in the respective region which was most likely located either in the *cabezadas* of the neighboring drainages or in the trans-*puna* highlands. Unfortunately, insufficient research and data publication currently impede testing the validity of this hypothesis. The motivation for the exodus is hard to explain from the archaeological evidence alone. Overwhelming military pressure from the lowlanders is not likely, since the highlanders were at least as numerous, had the same weapons, and lived in easily defensible places. Furthermore, they controlled the headwaters of the rivers and may well have been able to seriously disturb irrigation further downstream. Accordingly, they were in a stronger position. Other so far unknown economic and social or political factors must have been decisive.

If the *cabezadas* groups moved to another highland region, it also remains to be explained why so many new settlements were established at the foothills. At first glance, natural population growth seems to be an unrealistic explanation, given the fact that settlement area at the foothills increased during Late Paracas from only 6.3 ha at phase start to almost 50 ha at phase end. These numbers, however, refer only to preserved and documented sites. If many settlements of the Early and Middle Paracas phases were located at the valley floors, not at the margins, these would have been long covered by sediments and are, by now, almost impossible to detect by visual surface survey. In this case, local foothill dwellers of the earlier phases would have been much more numerous than can be inferred from surface remains. Population may have grown steadily until a point where cultivable land became sparse, and as a consequence, villages were gradually displaced to the agriculturally unproductive valley margins.

Interestingly, Anita Cook (1999), who surveyed the relatively narrow lower Ica valley, found much more Middle Paracas sites than did Sarah Massey in and around the extended floodplain to the north. This fits well with the notion that people moved to the margins as soon as irrigable land became a limiting factor for agricultural production being that this point would have been reached earlier in areas with very restricted valley floors. In the study area, sites like Jauranga (PAP-150) and Yunama (PAP-734) are clear evidence for the existence of villages at the valley floors in the pre-Nasca era, although their number is unknown.

Although population growth may have been quite moderate, it was accompanied by cultural changes possibly stimulated by external influences. For example, new burial customs were gradually introduced, including multiple burials, the use of urns, and the seated flexed position of the body, whereas in

¹²⁷ Markus Reindel, personal communication.

former times extended positions and individual tombs were the rule. These cultural changes may be purely autochthonous developments, the result of immigration of foreign groups, the product of indirect influences from the northern valleys, the highlands, or the SGD, or any combination of these. Unfortunately, Middle Paracas burials from the *cabezadas* have yet not been discovered, leaving it unclear whether these customs were already established in the highlands and later adopted by the foothill dwellers.

The stylistic and technical innovations in craft production during the Initial Nasca phase are often attributed to influences from a foreign society associated with the Topará style, which had its origins in the valleys of Pisco, Chíncha, and Cañete (cf. discussions in Silverman 1991 and in Tinteroff Gil 2008). In the NGD, but apparently also in Ica, sherds of Topará-like styles occur in association with Ocucaje 10/Nasca 1 material and hence do not seem to mark a foreign population culturally distinct from the locals. Accordingly, an immigration of groups from the northern valleys is unlikely.

In her PhD thesis, Vanessa Tinteroff (2008) argues that Cahuachi and its surroundings formed the core area where the Nasca culture gradually evolved as a *local* phenomenon, although it was heavily influenced by both, the latest Paracas (Ocucaje 10) and the Topará tradition and perhaps also impacted by currently still poorly researched highland cultures. While I agree with her that the development of the Nasca style was probably not the consequence of immigration from Pisco, Chíncha, or Cañete, a population exchange with the culturally similar Ica valley is more likely. The inhabitants of Ica should have been in more direct contact with Topará-related people and perhaps had already adopted some of their cultural traits. Unfortunately, Rowe and Menzel never adequately published the data of their Ica valley surveys. As a consequence, neither the size nor the exact location of many registered sites is known, except for the especially large and important ones mentioned in Menzel 1971 and Rowe 1963. Menzel (1971:47) reports that the Berkeley survey team found a total of seven Early Paracas sites in the upper valley, but she does not give site numbers for later phases. In any case, considerable differences in size would also have to be considered. Such differences can be deduced from the description of some particularly large sites, for example, the Middle Paracas settlement of Cerro Prieto in the upper Ica valley:

On the southern and eastern slopes there is an ample settlement which consists of alveolate concentrations of foundations corresponding to rectangular habitations made of rough stone, as well as of long and narrow terraces serving as bases for other structures. The dwelling zone is enclosed by an elaborated system of fortification walls which is especially reinforced at the western side which faces the desert. The whole dwelling area and the fortifications measure approximately two kilometers along a straight line. (Menzel 1971:77-78)¹²⁸

A large and well-defended Late Paracas settlement was registered at La Peña de Tajahuana in the middle Ica valley where “[m]ultiple fortification walls encompass an area of more or less one kilometer on the front side, provided with a dwelling section densely covered by the foundations of habitations and rectangular compounds measuring approximately 500 by 500 meters [...]” (Menzel 1971:80)¹²⁹

Massey (1986/1991) states that during the Late Paracas phase, the Ica valley became more centralized and integrated with the partly fortified site of Animas Altas serving as a capital center, while there was little evidence of earlier phases. The latter point may also be related to the problem of buried or destroyed Early and Middle Paracas settlements at the valley floors. Viewing the limited data from Menzel and Massey comprehensively, it seems that in the Ica valley population grew or remained at least stable between Middle and Late Paracas. Accordingly, people would not have emigrated in significant numbers.

The situation may have changed at the end of the Late Paracas phase. Massey argues that Animas Altas was probably abandoned as a consequence of armed conflict which she deduces from the numerous obsidian projectiles and spearheads scattered on the surface. Several other contemporaneous settlements were left as well (Massey 1986:299-301). Although systematic studies are lacking, few Late Initial and Early Nasca habitation sites have been reported from the Ica valley. This means

¹²⁸ My translation. Original reads: “Sobre las laderas meridionales y orientales se encuentra un amplio poblamiento que consiste en concentraciones alveoladas de cimientos correspondientes a habitaciones rectangulares, hechos de piedra tosca, así como largas y angostas terrazas que sirven de fundamento para otras estructuras. La zona de vivienda se halla circundada por un elaborado sistema de muros fortificados, que resultan especialmente reforzados por el lado occidental que da al desierto. Toda el área de viviendas y fortificaciones mide aproximadamente dos kilómetros en línea recta.”

¹²⁹ My translation. Original reads: “Múltiples muros de fortificación circundan un área de más o menos un kilómetro de frente, provista de una sección de vivienda densamente cubierta por cimientos de habitaciones y recintos rectangulares, que miden aproximadamente 500 por 500 metros [...]”

that population may have shrunk at the end of the Late Paracas phase, possibly as a consequence of armed conflict. Some displaced groups may have taken refuge in the NGD. If there was such a migration, these people might have introduced the Topará traits that are observable in many Initial Nasca ceramic assemblages from both drainages as well as other cultural changes.

The situation in the NGD, however, was not more peaceful, as fortifications like the great stonewall at Pinchango Viejo (PAP-11) and the frequent occurrence of sling stones suggest. Armed conflict, which is already observable during Middle Paracas, reached its peak during Late Paracas and decreased again towards the end of the Initial Nasca phase. It is tempting to suspect interethnic violence between *cabezadas* and foothill dwellers or between local Paracas people and Topará-associated invaders or raiders. Caution in rushing to such a conclusion is nevertheless highly advisable. Foothill and *cabezadas* people were economically complementary rather than in competition. Constant war would have threatened a crucial economic relationship. A Topará invasion is also unlikely because Topará material is generally found in Initial Nasca contexts, at least in the Ica and Nasca drainages. Accordingly, the Late Paracas descendants in these valleys either adopted some iconographic traits and perhaps also other cultural features from the Topará-associated population of the north or imported their vessels in great quantities. They may not have done this if they regarded the Topará-associated people as enemies.

A more convincing scenario may be competition among neighboring communities, arguably for farmland and irrigation water probably starting centuries before the emergence of the Topará style. If it is true that since the end of the Middle Paracas phase villages were gradually displaced to the valley margins in order to spare as much of the valley floors as possible for cultivation, it is also true that farmland had become a contested resource. Without a central authority managing rights of usage and negotiating conflicts, every community would have tried to defend or extend its share by force, if necessary.¹³⁰ The more successful clans may finally have achieved a position of some power and authority that enabled them to control resources and to quell conflicts. As a result, defensive measures gradually became obsolete. If, however, the relations between foothills and *cabezadas* groups were actually not as peaceful as proposed above, then the decreasing emphasis on fortifications during the Initial Nasca phase may also have been a consequence of the depopulation of the highlands. If there were no enemies, there were no concerns.

Climate Impacts

Mächtle and Eitel (2013) propose a generally stable arid climate for most of the time section in question. This is supported by Hesse's (2008:73) observation of widespread formation of irrigated anthrosols during the mid-first millennium BCE. The most notable change is the decreased variability of precipitation patterns since approximately 450 BCE. More reliable rainfall surely favored the establishment of many new settlements at the *cabezadas* and arguably also at the foothills, although the latter may have been located at the valley floors where they were later buried under sediments.

During the Initial Nasca phase, short-term dry episodes may have occurred, but apparently these did not discourage the extension of irrigation agriculture at the foothills. Instead, settlement patterns suggest that irrigation water was sufficient throughout the Late Paracas and Initial Nasca phases and that the possible dry periods during IN had no significant negative effect. This observation implies that the rivers carried enough water to irrigate almost all of the valley floors even if climate was near hyper-arid.

The dense colonization of the *cabezadas* during Late Paracas indicates especially favorable conditions at higher altitudes, suggesting not only sufficient rainfall but also comparatively mild temperatures. A number of villages are located at altitudes where the frost risk would have been high if the AMMTGS was more than 2 °C below the respective value for the 1950s. The fact that the few settlements that stayed occupied at the end of Late Paracas were not those located at relatively low altitudes implies that temperatures were still sufficiently high during at least the earlier half of the Initial Nasca phase.

As temperatures may have remained stable or even rose, and as precipitation also sufficed, climate can be ruled out as a major driving force behind the abandonment of the *cabezadas*. This means that

¹³⁰ Very clear evidence for violence between neighboring communities comes from the Acari valley, where Valdez (2009) found more than 70 slaughtered bodies representing both sexes and all ages at the site of Amato. Some of the dead were still tied with ropes and all had been decapitated.

independent cultural, social, and political processes would have been the cause. At the moment, these processes are not well understood because detailed archaeological data from regions neighboring the study area are sparse, especially regarding the highlands of Ayacucho and Andamarca, and the *cabezadas* of the other South Coast drainages. The present study may nevertheless serve as a cornerstone for a detailed reconstruction of supra-regional developments. This will be possible as soon as new field data from outside the Río Grande drainage becomes available.

7.5 Later Initial Nasca Phase to the End of the Early Nasca Phase (100 BCE – 300 CE)

The time between the later Initial Nasca phase and the end of the Early Nasca phase seems to have been stable and prosperous in terms of cultural development. Craftsmanship flourished and the exceptionally high quality of polychrome fine ware ceramic vessels and colorful bordered textiles requiring substantial labor investment argue for the emergence of full-time specialists. In the SGD, Cahuachi grew into the most important center of the Nasca culture and the only center with truly monumental temple mound architecture. Some scholars, namely Helaine Silverman, maintain that the site was mainly a pilgrimage center. In contrast, the general archaeological evidence, not only at Cahuachi itself but at much of the South Coast, seems to argue for a center of political power and even for a formal status of the capital of an integrated, centralized polity (see Chapter 3.2.4.2). With the rise of Cahuachi, the SGD became the focus of power and prestige at least for the Grande and Ica drainages which continued to maintain close cultural ties. In addition to the formation of a multi-tier settlement hierarchy, burial patterns also point to the emergence of a new ruling class. Contrary to Carmichael's (1995) conclusions, a number of clearly outstanding (unfortunately looted) Early Nasca elite tombs do exist in the Río Grande drainage, particularly at Cahuachi (Hecht 2004). Although they were still smaller than the Middle Nasca graves of La Muña (Isla Cuadrado & Reindel 2006), their existence indicates an increase in social differentiation.

In the study area, the last *cabezadas* settlements seem to have been abandoned before the end of the Initial Nasca phase. Only at Suito Orqo (PAP-873) and at PAP-1090, Early Nasca occupations (S-1709 and S-1304, respectively) might have been present, although the major part of the visible structures in both cases probably date to later phases, mostly to Middle Nasca. Settlements concentrated in the middle valleys and around the great floodplain. It would be highly interesting to compare this situation to the SGD, but the published data available to date does not permit to assess whether the upper valleys and the *cabezadas* of the SGD in general might have been densely populated during Early Nasca.

Population levels at the foothills apparently remained stable at best, or had slightly decreased. This is a surprising find for a time of cultural florescence and political stability but it may indicate that the land and water resources at the foothills were already fully in use, thereby preventing any further extension of agricultural production. Consequently, it was not possible to feed a still larger population, which may have forced emigration. These emigrants did not move to the *cabezadas*, which remained largely uninhabited. This observation once again shows that, although people were mobile when necessary, they did not easily occupy an environment with which they were not familiar. Some groups may have moved to the Ingenio valley and the SGD where settlement numbers rose, according to data from Silverman and Schreiber, respectively, which I discussed elsewhere (Soßna 2012). Others could have gone to the Ica valley, although the very limited published data suggests a relatively low population density there as well.¹³¹ Accordingly, the immigration of larger groups from the NGD is unlikely. The Early Nasca influence on the Huarato culture in Acarí (Valdez Cárdenas 2006/2009) and on the Carmen culture in Pisco and Chíncha (Velarde 1993, Wallace 1972) could perhaps be related to smaller groups of emigrants from the NGD who merged with the respective local populations.

No Early Nasca settlement in the study area shows any kind of defensive walls or caches of sling stones. The finding of trophy heads in archaeological contexts and their iconographic representation on vessels and textiles (but also as parts of some geoglyphs) is sometimes interpreted as an indicator of warfare (e.g., Proulx 2001) but, as Proulx rightly noted:

¹³¹ Massey (1986/1991) and Cook (1999) both concentrate on the Paracas Period and the Initial Nasca phase. Menzel's (1971) information on settlements is limited to the Paracas period and the Late Nasca phase. Rowe (1963:11) mentions the two large sites of Cordero Alto and Cerro Soldado which is not enough to get a general idea of the population density of the whole valley.

This theory of inter-valley secular warfare needs to be further tested in the future by examining the settlement patterns revealed by the various, but yet unpublished, surveys which have recently been undertaken in the Nasca drainage (e.g. Schreiber's work in the Taruga, Las Trancas, Tierras Blancas and Aja tributaries, Silverman's work in the Ingenio Valley, Browne's survey of the Palpa region, and Carmichael's work in the lower Río Grande). The presence of fortifications or strategically positioned sites in critical locations could add to our understanding of the nature of Nasca warfare. (2001:129)

To judge from the study area, if battles did take place, they apparently did *not* affect the settlements, since villages were neither fortified nor located in defensive positions. Some kind of "war," not aiming on conquest or booty, may nevertheless have taken place in a ritual context. Perhaps parties drawn from a specific warrior class met on a determined field to fight a ritual battle which ended in the decapitation of the captives. Ritual battles are well known in the Central Andes from ethnographic and ethnohistoric parallels. This holds especially true for the so-called *tinku*. During a *tinku*, two parties, often two moieties of the same society, engage in a fight during which serious and sometimes deadly injuries can occur. *Tinkus* are known to have been practiced at least since the Late Horizon in many highland regions but its roots may well reach far more back in time. It may have been much bloodier in its origins.¹³² Ritual or not, anthropological analyses show that the trophy heads were of local origin, thereby providing good evidence against a scenario of conflicts between Nasca people and foreign groups (Knudson et al. 2009).

The lack of evidence for warfare, other than perhaps a regulated intra-society variety, is consistent with a scenario of a unified polity not seriously threatened by external forces. If Cahuachi was indeed the capital of such a polity, settlements like Los Molinos and especially Llipata, San Antonio, and La Falda would have served as subordinate centers for the administration of certain drainage sections. The same could be said for Silverman's site 165 (Ventilla) in the Ingenio valley (Silverman 2002:50-57), and probably, comparable installations also existed in the valleys of the SGD. Monte Grande/Pedregal close to the mouth of the Río Grande also seems to have been an important Early Nasca center, arguably for its proximity to both the coast, with its marine resources, and to the lowermost Ica valley. The settlement therefore combined economic importance with a strategic location regarding the control of traffic between the Ica and Río Grande drainages but also between the coast and the foothills. In Ica itself, the settlements at Cordero Alto and the slightly later one at Cerro Soldado (Rowe 1963:11) might also have fulfilled the function of local centers, possibly related to Cahuachi.

Altogether, the archaeological evidence of the Early Nasca phase fits best into a scenario of relative peace guaranteed by a central authority ruling from Cahuachi with the help of local governors in the different valleys. This political stability allowed a prosperous development of craftsmanship, stable agricultural production, and an increase in social differentiation and complexity. Stability and unity may also have helped to manage temporal crises caused by occasional local-level crop failures, because a central authority could have organized storage and redistribution of food on a regional level.

Sometime around 300 CE, the Early Nasca polity apparently collapsed for reasons still not well understood. Cahuachi was abandoned and its temple mounds were ritually buried. Subordinate local centers, including Llipata and Los Molinos, were also given up. The breakdown of socio-political organization was accompanied by a sudden and severe decrease in population as suggested by the drop of total settlement area in the NGD from 72 ha to 46 ha by end of the Early Nasca phase. This development does not seem to have been limited to the Río Grande drainage and the Ica valley but is also observable in Acarí. Valdez notes that "[i]t is important to underline that around that phase [Nasca 4 (early Middle Nasca)] the Acarí sites were depopulated or even abandoned while the major part of the population of this valley concentrated in Chaviña (PV 74-22), a site located close to the ocean" (Valdez Cárdenas 2000:21).¹³³

For the northern valleys, the published information is very limited. Wallace notes that in Chincha during the Carmen phase, which is contemporary to Early Nasca, "construction of pyramids continued, though fewer in number and smaller in size, and without the specific shape of the earlier ones" and that "[u]rban centers occur in both valleys [Chincha and Pisco]" which are "compact and irregular aggregations of habitations with plazas but without pyramids or other special constructions"

¹³² See Arkush & Stanish 2005 and Arkush & Tung 2013 for a discussion on Andean warfare and its archaeological traces. The authors also prominently treat the aspect of ritual battles.

¹³³ My translation. Original reads: "Es importante subrayar que alrededor de esta fase los sitios de Acarí fueron despoblados o, incluso, abandonados, al concentrarse gran parte de la población de este valle en Chaviña (PV 74-22), sitio ubicado en las cercanías del mar."

(1972:2).¹³⁴ One of the latter is located in Chincha and two in Pisco. For the following Estrella phase, contemporaneous with Middle and Late Nasca, Wallace states that:

[t]here are some small mounds associated with ESTRELLA ceramic at the floor of the Chincha valley, constructed with semi-cylindric adobes, at the end of the period with concave sides or half-reel. The largest one is site PV57-5 in the middle of the valley. It is the only one which could be interpreted as pyramid with some certainty. Habitation sites occur with regular frequency at the valley floor, some further upstream than before. None is large so that evidence of the urban center of Chincha is missing. In contrast, in Pisco, sites with ESTRELLA ceramic or adobes half-cylindric adobes are located at the margins of the upper and lower valley. Some of those in the upper valley are extended in area, suggesting [to have formed] the urban center, but lacking the well-defined fringes of the previous centers. Photographs of Shi[p]pee and Johnson taken 40 years ago show very extended terraces which should belong to the period. (1972:3)¹³⁵

Canziani (2009:292-297) merges both phases, making it impossible to notice developments from his data. Altogether, it appears that settlements were becoming simpler and, at least in Chincha, more dispersed, although population remained basically stable, or even increased. Accordingly, Pisco and Chincha could perhaps have absorbed some smaller groups of refugees who fled the Nasca-Palpa region. Future field work at all of the South Coast but especially a complete and adequate publication of old survey data may shed more light on the issue of what happened at the end of the Early Nasca phase.

Climate Impacts

The cultural heyday, the formation of an at least drainage-wide integrated polity, and a still relatively high population level do clearly not suggest an agricultural crisis caused by very unfavorable hyper-arid and volatile climate conditions. Indeed, the geomorphological evidence presented by Mächtle and Eitel argues against major violent fluvial events (Eitel & Mächtle 2009, Mächtle 2007, Mächtle & Eitel 2013) while the valley floor sediments analyzed by Hesse and Baade (Hesse 2008, Hesse & Baade 2009) indicate stable and large-scale irrigation over several centuries, which implies a regular river runoff. The settlement density in the middle valleys and around the great floodplain also suggests prosperous irrigation agriculture made possible by a stable and sufficient supply with river water. Although such climatic conditions surely favored a cultural bloom, they cannot be seen as a trigger for this development because the advantageous conditions were already prevailing since the end of the Middle Paracas phase. Likewise, the apparent collapse of the Early Nasca polity and the emigration of a significant part of the population of the NGD and arguably also the neighboring regions was almost certainly not caused by worsening climate conditions. A relatively stable and arid climate can be assumed to have persisted until at least the beginning of the Late Nasca phase. Although minor short-term events can never be excluded (given the limited resolution of the geoarchives) these would probably have been dealt with effectively since the locals should have been used to occasional droughts and floods.

As soon as complementing data is available, especially from pollen analyses, the question can be addressed, whether perhaps the *cabezas* remained largely un-colonized during Early Nasca due to very low temperatures. For the harvests in the settled sections of the study area, temperature was insignificant because there was surely no frost risk at those altitudes. Even the Early Nasca village at the highest altitude, S-1709 (Suito Orqo), if it had indeed been occupied at that time, is located below the -4 °C frost margin.

¹³⁴ My translation. Original reads: “[...] la construcción de pirámides continua, aunque menos en número y tamaño, y sin la forma específica de los anteriores. [...] Centros urbanos ocurren en los dos valles; son agregaciones compactos e irregulares de habitaciones, con plazas pero sin pirámides o otras construcciones especiales.”

¹³⁵ My translation. Original reads: “Se encuentra en el piso del valle de Chincha unos montículos asociados [sic] con la cerámica ESTRELLA, construidos de adobes medios cilíndricos, al final del período con lados concavos o medio carrete. El más grande es el sitio PV57-5 en medio valle; es el único que se pueda interpretar como pirámide con alguna seguridad. Sitios de habitación ocurren con frecuencia ordinaria en el piso del valle, algunos más río arriba que antes; ningunos son grandes de modo que se falta evidencia del centro urbano de Chincha. En contraste, sitios con cerámica ESTRELLA o adobes medios cilíndricos en Pisco quedan en los bordes del valle abajo y valle arriba. Algunos del valle arriba son extensivos en área, sugiriendo el centro urbano, pero sin los bordes bien definidos de los centros anteriores. Fotografías de Shi[p]pee y Johnson tomado hace 40 años muestran terrazas muy extensivas que deben pertenecer al período.”

7.6 Beginning Middle Nasca Phase to the Beginning Early Wari Phase (300 – 700 CE)

At the dawn of the Middle Nasca phase, notable changes in socio-political organization occurred. The drainage-wide or even multi-valley polity dissolved and its capital at Cahuachi was largely abandoned. Shortly thereafter, new local centers of power emerged in different valleys and valley sections, including La Muña (S-41) in the Río Grande valley and Viscas (S-47) in the Viscas valley. There seems to have been a growing desire for individual prestige and representation in the social elites, judging from the extraordinarily large and rich tombs at La Muña and Puente Gentil (Isla Cuadrado 2001a, Isla Cuadrado & Reindel 2006). These finds suggest that the political fragmentation was accompanied by an increase in social differentiation.

Despite the considerable social and political changes, the culture in general developed smoothly. No major innovations, such as markedly different burial customs or ceramic styles, are observable prior to the Early Wari phase. There are, however, signs of an increasing interaction and mutual influence between the South Coast and the Ayacucho highlands, especially during the Late Nasca phase. In addition to obvious Nasca traits being incorporated into the Late Huarpa and Early Wari styles (Knobloch 2005, Menzel 1964), the increase of stone built special architecture at the expense of *adobe* buildings at the foothills of the Río Grande drainage might also reflect a highland influence in the Río Grande drainage. Especially interesting is the Late Nasca/Early Wari settlement at Huaca del Loro (Paulsen 1983, Schreiber 1988, Strong 1957) in the SGD whose round structure is reminiscent of the East Plaza at Ñawinpujyo near Ayacucho (Leoni 2009).

The intensification of relations between the Río Grande drainage and the Ayacucho region may initially have been catalyzed by the massive resettlement of the *cabezadas* during the Middle Nasca phase. In these highland sections of the study area, Middle Nasca architectural patterns and settlement layout are similar to those of Late Paracas times, except that there are no flower structures. In several cases, stratigraphically discrete occupations of both phases can even be found at the same site. The typical village consisted of circular stone houses mostly with double walls, built on terraces which were arranged concentrically around a hilltop. In turn, these villages are markedly different from their foothills counterparts, which were predominantly composed of angular structures in flat terrain or on modest slopes along the valley margins.

The total settlement area at the foothills is significantly lower than in the preceding Early Nasca phase, but the comparatively short duration of the Middle Nasca phase (some 140 years) increases the probability of contemporaneity, especially of the many d-type settlements comprising 44% of the overall dwelling area. Consequently, it is very possible that the population shrank rapidly at the end of Early Nasca but then recovered to a certain degree during Middle Nasca, before diminishing once again.

Comparable to the situation during the Late Paracas phase, a population shift inside the study area from the foothills to the *cabezadas* can be assumed at first glance. At closer look, however, some doubts arise, considering the differences in architectural design and settlement layout which suggest general cultural and probably also ethnic differences between foothills and *cabezadas* groups. Furthermore, since no highland village seems to have a direct Early Nasca precursor, most were probably not established during the transition between Early and Middle Nasca but at least several decades later when many Early Nasca settlements had already been abandoned. Accordingly, the two processes – population decline at the foothills and repopulation of the *cabezadas* – may have run subsequently rather than simultaneously. This would mean that the establishment of villages in the highlands occurred at a time when the population around Palpa was already recovering.

Interestingly, the settlement at Marcaya, located in the SGD at a comparatively low altitude of only 1000 m.a.s.l. (Vaughn 2000/2009) shows close architectural similarities to the Middle Nasca *cabezadas* villages of the NGD, but is associated with material attributable to the styles Nasca 3 and Nasca 4. While Nasca 3 undoubtedly belongs to the Early Nasca phase, Nasca 4 marks the beginning of the Middle Nasca phase in the chronological scheme employed in the present study. According to Schreiber's (1988) brief comments, there seem to have been a few other Early Nasca villages of this type in the area but the majority of the domestic sites date to Middle and Late Nasca or even later. Foreign highlanders possibly occupied the upper and middle valleys of the SGD first and went on to the NGD some decades later. In this case, Marcaya and its neighbors would have been non-Nasca settlements and their close relation to Cahuachi assumed by Vaughn would be in doubt. At Marcaya, however, pure Nasca fineware sherds were found in large quantities. This contrasts with the compara-

tively few sherds of this type found in Middle Nasca *cabezadas* settlements of the NGD. More field work at different types of ordinary Nasca habitation and burial sites would be necessary to clarify whether the population in all of the drainage was culturally and ethnically uniform. Currently, I consider a scenario of cultural and ethnical distinction between foothill and *cabezadas*/upper valley dwellers more likely, at least with regard to the NGD.

The population dropped again by the end of the Middle Nasca phase at both the foothills and the *cabezadas*. This process seems to have continued throughout the Late Nasca and the Early Wari phases. Despite the significant population decline and the abandonment of the most important local centers, which can be seen as an indicator for a crisis of the socio-political system, there is no widespread evidence for conflict. Defensive walls and sling stone deposits are absent and no effort had been made to move settlements to defensive locations. While many *cabezadas* villages were located at elevated but unfortified locations, foothills settlements remained easily accessible. There are no obvious destruction layers, nor evidence for mass executions, nor clear indicators for any kind of catastrophic event killing thousands of people. Since there are no signs of a drastically increased mortality rate, the only logical explanation for this population drop is emigration.

This provokes the question where people went to. Foothill and *cabezadas* dwellers possibly took refuge in different regions. At the foothills, the simultaneously occupied dwelling area at the start of the Late Nasca phase amounted to some 21 ha. Of these, 14 ha were still occupied at the phase's end but were finally abandoned during the Early Wari phase. Accordingly, if all emigrants went to the same region, settlement area there should have increased in a similar dimension. Decreasing settlement numbers have also been observed in the Ingenio valley (Silverman 2002), while in the SGD lower numbers may have been compensated by larger size. Judging from the maps and some general comments published by Schreiber and Lancho (2003:142-148), the number of settlements dropped drastically between Early and Middle Nasca and slightly between Middle and Late Nasca. At the same time, however, settlement size grew, particularly during Late Nasca. Accordingly, population did not shrink in proportion to the number of villages. It may even have increased.¹³⁶ Even a slight population increase in the SGD would nevertheless not have fully compensated for the decline in the NGD.

The northern South Coast valleys, where stylistic influences from Nasca are clearly observable in local ceramics, come to mind as the possibly main destination for emigrants from the NGD (e.g., Menzel 1971:126-131, Santa Cruz Gamarra 2007:104-105). In her 2001 article, Schreiber states that "there is no evidence that a drastic population increase took place neither in Ica nor in the southern valleys [of the Río Grande drainage]" (2001:440).¹³⁷ In case of Ica, however, she might be wrong. Unfortunately, neither a map nor a catalog of the sites registered by Menzel in the Ica valley has ever been published. For this reason it is impossible to make more precise statements about changes in the size and number of settlements there, but in general terms, Menzel states that "it is surprising that to date no Monumental [Early-Middle] Nasca settlement of a similar extent [compared to the large ones of the Middle and Late Paracas phase] is known in the Ica valley" (1971:83). Later on, she assumes that "the occupations of late periods buried or destroyed some of the older [Nasca] settlements on the plain, possibly even an extended Monumental Nasca center, comparable to those of Pisco, Nasca, and Acarí [...] [because] there is relatively little information about settlements of the Early Intermediate Period, principally with regard to [Middle Nasca] phases 5 and 6 [...]. Without doubt, more settlements corresponding to these phases must have existed, but to date we have not discovered their kinds of occupation." (1971:92-93)¹³⁸

Although Menzel might be correct in that some Early and Middle Nasca settlements were located at the valley floor and had been destroyed or covered before her survey in 1958, Late Nasca villages and centers were apparently larger and more numerous. She reports "14 large settlements [...] in the upper and middle parts of the valley, as well as several further places [...] where some Nasca 7

¹³⁶ The comparability of Silverman's and Schreiber's data to that gathered by the Palpa Project is limited due to differing methods in documentation and analysis, but general trends can be deduced (cf. Soßna 2012).

¹³⁷ My translation. Original reads: "Sin embargo, no hay evidencia de que se diera un aumento drástico de población ni en Ica ni en los valles del sur."

¹³⁸ My translation. Original reads: "[...] es sorprendente que hasta ahora no se conozca ningún establecimiento similarmente amplio del Nasca Monumental en el valle de Ica."

"[...] que las ocupaciones de los periodos tardíos sepultaron o destruyeron algunos de los más antiguos asentamientos de la planicie, hasta posiblemente un amplio centro de Nasca Monumental, tal como aquellos de Pisco, Nasca, y Acarí [...]"

"[...] hay información relativamente escasa sobre los asentamientos del Periodo Intermedio Temprano, principalmente en lo que se refiere a las Fases 5 y 6 de Nasca [...]. Es indudable que deben existir más asentamientos correspondientes a estas fases, pero hasta ahora no hemos descubierto sus formas de ocupación."

ceramic sherds were found together with other refuse" (Menzel 1971:86).¹³⁹ If each of the 14 large settlements only comprised 3 ha on the average, their overall area would sum up to 42 ha, which is twice the area abandoned in the NGD since the end of Middle Nasca. Accordingly, the upper and middle Ica valley could indeed have been a destination for Late Nasca emigrants from the study area.

For the Pisco and Chincha valleys, Wallace (1971) reports 19 sites for his phases Estrella 1-3 (contemporaneous to Middle Nasca) versus 11 for Estrella 4 (corresponding to Late Nasca), but the information given in his catalog is limited. The area estimates are very rough, and even in the Late 1950s, when fieldwork was carried out, large parts of many sites had already been destroyed. In a later supplement to the catalog, Wallace gives some information on his Estrella phase in general without distinguishing sub-phases (quoted on p. 228). Despite the patchiness of the data, in the Pisco and Chincha valleys too, a decrease in settlement area is more likely than a significant increase. Consequently, the Ica valley is the only place on the South Coast where emigrants from the NGD might have moved to during the Late Nasca phase and perhaps also during the Early Wari phase.

In addition, some groups might also have crossed the *puna*. In her 2001 article, Schreiber remarks:

If [the Late Nasca inhabitants of the NGD] moved all together to another place, one would expect finding evidence of this movement in the form of changes of style in the artifacts in the new region, including both, the design and the technology of the Nasca-style pottery. The only culture of the Early Intermediate Period exhibiting this kind of change is the Huarpa culture of Huamanga [Ayacucho], which makes it a promising object for future research. (440-441)¹⁴⁰

While she was wrong in that strong stylistic influences from Nasca were limited to the Ayacucho region, (they are also observable in the northern South Coast valleys), Ayacucho and its hinterland may at least have absorbed part of the population of the NGD. Apart from the strong Nasca influence in the Late Huarpa and Early Wari ceramic styles (Knobloch 2005, Menzel 1964), Valdes et al. note that burial practices may have been influenced, too:

Carmichael (1995) observed that a common Nasca burial position was seated, with the lower limbs flexed toward the chest. Likewise, Massey (1986: 323) reported stone-lined pits covered by stone slabs that date to the Early Intermediate Period (AD 1–600) in the upper Ica Valley. Since similar cists and similar body positioning were unknown in the Ayacucho Valley before the Middle Horizon, it is worth pursuing the possibility that perhaps the Nasca introduced cist tombs to the Ayacucho Valley. Certainly, we are not arguing that is the case, but it is a possibility that simply cannot be bypassed particularly considering that for long time scholars have argued about the Nasca influence in the Ayacucho Valley [...]. (2006:684)

Emigration across the *puna* possibly offered an effective outlet for population pressure. For some reason, this option may not have been available during Late Paracas, when serious fighting is easily recognizable in the archaeological record and settlement behavior clearly shows defensive considerations. Archaeological data from both Ica and Ayacucho so far could at best explain where the inhabitants of the NGD might have moved to during the Late Nasca and Early Wari phases. The destiny of the people who left the study area at the end of the Middle Nasca phase, in turn, still remains in the dark. Foothills and *cabezadas* dwellers were possibly slowly assimilating during Middle Nasca, and already before the start of the Late Nasca phase larger groups of the lowlanders left together with the highlanders for the wider Ayacucho region. This hypothetical scenario will have to be checked with data from ongoing and future projects in the Ayacucho region.

Climate Impacts

Without widespread evidence for destructive wars or plagues, the principal reasons for the decline in population towards the end of the Nasca Period were most likely economic in nature. The dissolution of the pan-Nasca polity and the loss of a central authority managing to a certain degree the storage and distribution of staple goods may have reduced the society's resilience buffer against crop failures. If either agricultural yield significantly declined on the average or bad harvests repeatedly occurred

¹³⁹ My translation. Original reads: "[...] 14 gran des asientos así como varios otros lugares adicionales [...] en los cuales se hallaron algo de cerámica de Nasca 7 junto con otros residuos."

¹⁴⁰ My translation. Original reads: "Si se hubieran trasladado conjuntamente a otro lugar, se esperaría encontrar evidencias de este movimiento en forma de cambios en el estilo de los artefactos en la nueva región, incorporando tanto los diseños como la tecnología de la cerámica de estilo Nasca. También se esperaría encontrar cambios en los estilos arquitectónicos y en los patrones de asentamiento, reflejando la presencia de recién llegados. La única cultura del Periodo Intermedio Temprano que exhibe este tipo de cambios es la cultura Huarpa, de Huamanga, lo que le convierte en objeto prometedor para estudios en el futuro."

during several subsequent years, the impact would have been more severe. Declining yields can be caused by a variety of factors. These include

- insufficient maintenance or deliberate destruction of irrigation networks due to political instability
- soil degradation
- reduced or irregular precipitation

The absence of evidence for widespread war and the apparently well-founded power of the Middle and Late Nasca lords in their respective territories are evidence against the first point, and the intensive and long-lasting cultivation of the valley floors in later periods negates the second. A comparison of settlement patterns at the start and at the end of the Late Nasca phase, in turn, clearly shows that the largely abandoned areas were those with the most critical water supply: the lower sections of the rivers, the valleys of the smaller rivers with the lowest discharge volume (Palpa and Viscas), and the lower reaches of the *cabezas* where local precipitation is lower than at greater elevations.

The dislocation of settlements would be logical if the climate had suddenly turned much drier causing shortages of irrigation water downstream at the lowermost reaches of the Palpa and Viscas rivers. In this case, people would have concentrated on cultivating the valley sections where the most reliable harvests could be expected. For the first time, the limiting factor for agricultural production would not have been the availability of cleared land but of irrigation water. For the SGD, Schreiber and Lancho conclude that the *puquios* were built in Middle Nasca times as a response to drier conditions (Schreiber & Lancho Rojas 2003). Accordingly, a scenario of increasing aridification would go well with the archaeological record. The question is whether it is also supported by independent evidence from geoarchives.

Unfortunately, no geoarchives were found around Palpa that could show the development between 300-650 CE in detail. The valley floor sediments analyzed by Hesse and Baade (Hesse 2008, Hesse & Baade 2009) seem to signal steady, long-term irrigation and occasional riverine flooding as a general trend. Data from remote geoarchives also suggest relatively favorable conditions in the Río Grande drainage during the Middle Nasca phase and the beginning of the Late Nasca phase (300-500 CE), allowing for a recovery of population levels, but there is no evidence for worsening climatic conditions at the end of the Middle Nasca phase. Accordingly, there were either other reasons for the gradual abandonment of the great floodplain, or the resolution and accuracy of the current climate model do not allow identifying short-term fluctuations that lasted for less than a few decades.

A short-term return to near hyper-arid conditions may have occurred in the Late Nasca phase during the early 6th century CE. This is suggested by the chlorin curve, though the respective peaks in the other curves are much less pronounced. Such a multi-decadal drought may have intensified migration from the NGD to the Ica valley. If this is true, it would have had a greater impact than those of the two short-term droughts which probably occurred during the Initial Nasca phase and which do not seem to have affected settlement behavior and population levels significantly. The general socio-political situation was possibly much more fragile during Late Nasca.

In the Ica valley, Late Nasca settlements were located in the upper Ica valley where water was available more reliably than further downstream. If population density was very low during Middle Nasca, as suggested by the paucity of settlements from that phase, the Ica valley might still have had the potential to feed more people, even under dry conditions if adaptive measures were applied. Menzel laid out a test pit in a Late Nasca settlement at the site of La Tinguíña (PV62-70) in which she observed a superposition of several layers containing domestic architecture and refuse, pointing to a long occupation span. Interestingly, the well preserved botanic remains of crop plants argue for a change in agricultural strategies in the course of the Late Nasca phase with an increasing emphasis on crops with a shorter vegetation period (less corn, more gourd) which “would definitely suggest a shortage in water supply during the epoch when the upper layers formed” (Menzel 1971:90).¹⁴¹

At the *cabezas* of the NGD, only three or four settlements were still occupied at the beginning of the Early-Middle Wari phase. These were all located at high altitudes around 3000 m.a.s.l. where precipitation should still have been sufficient even under comparatively dry conditions while the frost risk would have been low, even if the AMMTGS had been up to 4°C lower than in the 1950s. The inhabit-

¹⁴¹ My translation. Original reads: “[...] sugería muy definitivamente la escasez de abastecimientos de aguas por la época en que se produjo la ocupación de los niveles superiores.”

ants of the few smaller villages that were abandoned might have moved to the Ayacucho region. Since they will have been few in numbers they would have easily been absorbed by the locals. Furthermore, the Ayacucho and Andamarca regions east of the *puna* may have been less affected by a dry period. Since they receive more precipitation in absolute amounts, a modest decrease is less dramatic than in the study area. Additionally, the expansion of terrace construction may have increased the agricultural potential. In effect, not only the autochthonous population but also smaller groups of immigrants could be fed.

After 550 CE, at the height of the Late Nasca phase, average rainfall in the NGD seems to have increased again, but population did not recover noticeably and the people who had left some decades before did not return. For the period from 650-770 CE (largely corresponding to the Early-Middle Wari phase) several geologic profiles laid out around Palpa support a scenario of an increasing variability of precipitation with frequent droughts but also occasional flash floods (Mächtle 2007, Unkel & Kadereit et al. 2007). By 750 CE almost all local and remote geoarchives suggest a sudden and drastic reduction in precipitation in the Río Grande drainage for at least half a century. This phase was probably the driest since the early 9th century BCE and will have seriously affected both rain-fed and irrigation agriculture. It very likely caused the final abandonment of the last Nasca-related (Loro) settlements at the foothills while the few remaining *cabezadas* dwellers managed to survive, possibly thanks to improved agricultural terraces allowing for a more effective water storage and distribution.

7.7 Middle of the Early Wari Phase to the End of the Middle Wari Phase (700 – 850 CE) and Hiatus (850 – 1180 CE)

During the Early and Middle Wari phases the Nasca culture finally faded and the Nasca heartland was firmly incorporated into the Wari Empire. The roots of this process might reach as far back as into Middle Nasca, but it clearly gained momentum during the 7th century CE and culminated into a complete acculturation by about 800 CE. At the foothills, some Late Nasca settlements stayed occupied for a while. These were apparently inhabited by locals who had incorporated cultural traits from Ayacucho, particularly with regard to their pottery design (Loro) and their burial customs. These burial customs were manifold and also included at least one variant probably derived from older Nasca customs: so-called *barbacoa* elite tombs like the graves at Parasmamarca and Huaraco/Lucriche (Isla Cuadrado 2001b/2009). Wari-influenced elites may have adopted this Nasca tomb form but modified it according to highland customs, in that they constructed the chambers in a way that allowed re-entry. *Barbacoa* tombs dating to the Nasca Period showed no sign of reopening and their chambers were often intentionally filled. Other Middle Horizon grave types, especially the stone *kuntis* at the *cabezadas*, had no local precursor and were clearly introduced from somewhere across the *puna*.

Only few descendants of the Late Nasca population remained at the *cabezadas*. The people who settled the area in greater numbers were predominantly immigrants from the Ayacucho region, but most of them did probably not arrive before the end of the Early Wari phase when the foothills were already largely depopulated. Due to the lack of numeric dates from *cabezadas* sites, a more accurate temporal fixation of the beginning and the duration of the Wari occupation of the highlands is not possible at the moment.¹⁴² The immigrants from Ayacucho erected orthogonal administrative complexes, ceremonial D-shaped buildings, and *kuntis*. While orthogonal complexes were already known locally (at the foothills) the other two types of architecture had no precursors in the Nasca tradition.¹⁴³ The newcomers also expanded camelid herding, though agriculture still seems to have formed the economic backbone.

Although there is a general agreement that mutual cultural influences between the Nasca and Ayacucho regions were very strong at the end of the Early Intermediate Period and the beginning of the Middle Horizon, the nature of this relation is still not well understood. A scenario of military conquest is

¹⁴² Most MH styles were defined via the seriation of pots from museum collections (Menzel 1964). A relative sequence is not always firmly established and confirmed by stratigraphic evidence from excavations. Numeric dates are still sparse and not always reliable. See discussion in Chapter 5.2.2.

¹⁴³ There was a tendency towards the erection of strictly rectangular administrative structures at the foothills since Early Nasca, e.g., at Los Molinos (Early Nasca, Figure 87), Viscas (Middle Nasca, Figure 91), and Parasmamarca (Late Nasca, cf. Figure 97). The replacement of *adobe* by stone since the Middle Nasca phase, in turn, may not be a local development but may point to cultural influence from the highlands already under way.

not supported by the archaeological evidence. As in the previous phases, there are no obvious signs of defensive measures. Neither the Loro-associated foothill villages nor the Wari centers at the *cabezadas* were protected by walls. The Wari did also not erect buildings which could be interpreted as military garrisons established in order to control a local population by force. Wari elites and local commoners lived together peacefully in several settlements, at least in the *cabezadas* sections of the study area (e.g., at Huayuncalla), a fact contrasting Conlee's and Schreiber's hypothesis of a resisting Nasca community in the Las Trancas valley (Conlee & Schreiber 2006). The lack of any indication of threats by hostile war parties and the deliberate mutual adoption of cultural traits better support the idea of some degree of mutual appreciation and respect. While we cannot know for sure if locals actually welcomed the highlanders, they apparently did not try to repulse them, either. Given the low population density at the *cabezadas* during Late Nasca and the probably already advanced depopulation of the foothills before the main wave of Wari people arrived, the local population would also not have had the manpower to successfully ward off an invasion.

The Wari established several administrative centers in the Río Grande drainage, which clearly indicates that they formally incorporated the area into their realm during the Middle Wari phase. In the NGD, all of these centers are located at the *cabezadas*, the most important being Ayapampa (S-1682), Pacapacari (S-1740), Huayuncalla (S-161), and Mauca Llaqta (S-121). In the SGD, Pacheco might have functioned as a center, but due to the almost complete destruction of the site, a clear determination of its status has become impossible (Schreiber 2001). Another small Wari center existed at Pataraya in the upper Tierras Blancas valley (Edwards 2010).

After the Middle Wari phase, the settlements at the *cabezadas* of the NGD were also abandoned. To date, no domestic occupation dating later than 850 CE and earlier than 1180 CE could be documented at any site. In the future, additional excavations and numeric dating may perhaps reveal that smaller groups of people actually continued to inhabit some villages, but even if this was the case, population density must have been extremely low.

At the foothills the existence of dwellings also cannot be excluded. The few remaining farmers might have moved to the valley floors proper to be as close as possible to their fields. Since population levels were low, there was no need any more to spare land for cultivation. Their houses, probably built of light, perishable material, would long have decayed or been buried. Accordingly, Hesse's assumption that irrigation had never ceased completely could be correct, although the scale of agricultural activity will have been reduced significantly. Of the 43 ^{14}C samples taken from sediment profiles and published in Hesse & Baade 2009, four fall within the time span between 660 and 1200 CE but only two of these represent layers interpreted as irrigated anthrosols.¹⁴⁴

Late Wari tombs were excavated at several locations in the SGD and in the Monte Grande area (Menzel 1964:63). Furthermore, a map published by Conlee and Schreiber (2006:103) shows numerous cemetery sites and 16 settlements attributed to "Middle Horizon 3 and 4" (Late Wari), though no additional information is given. Numerous Late Wari pots originating from tombs in the Ica valley are known from private collections but no habitation sites were so far reported from that valley (Menzel 1964:62-66).

The abandonment of the study area coincides with the apparent fall of the Wari Empire which is detectable in the archaeological records for most of its former provinces at the end of the Middle Wari phase. Contrary to other regions, however, – for example Moquegua (Sutter & Sharratt 2010), Chichasoras (Meddens & Branch 2010), Sondondo (Schreiber 1992:160-163), Huamachuco (Topic 2009), or Cusco (McEwan 1987:79-83) – the study area was not only left by the Wari immigrants from Ayacucho or their direct descendants but also by most of the last remaining natives. This fact raises the question of where the population of the NGD went. Since Late Middle Horizon evidence from the northern South Coast valleys is also sparse the Wari homeland in the wider Ayacucho region may have been the principal destination. Research focusing on the *Late Wari* phase is still too limited to test the validity of this hypothesis, since detailed, systematic settlement pattern studies at a regional scale in the Ayacucho basin were either not carried out or have not been published properly.¹⁴⁵

It must be kept in mind that population levels in the study area had already been low at the beginning of the Early-Middle Wari phase. Accordingly, there will not have been masses of emigrants but

¹⁴⁴ The two samples are Poz-16820 from profile SF2, 870-1020 cal CE and Poz-13547 from profile FI, 890-1030 cal CE. Both profiles were laid out between the Palpa and Viscas rivers, south of the town of Palpa.

¹⁴⁵ The survey by Lumbreras carried out during the Ayacucho Archaeological-Botanical Project (McNeish et al. 1981) may still be the most universal effort, although it remains poorly published.

perhaps a few thousand people leaving in small groups over the course of several decades. Such numbers could have been absorbed easily by local populations in regions with generally more abundant resources than the NGD.

Climate Impacts

Geoarchives point to sudden and extreme aridity between 700-CE followed by a phase of about 150 years (ending around 1050 CE) during which more favorable conditions prevailed. The archaeological record supports an ongoing depopulation of the foothills during the Early Wari phase leaving the area almost completely uninhabited by around 800 CE. This depopulation of the foothills may well have been related to a breakdown of irrigation agriculture due to a multi-decadal period of insufficient and unreliable river discharge. In turn, the *cabezadas* seem to have been populated by immigrants from the Ayacucho region who joined the few remaining locals at the end of the Early and the start of the Middle Wari phase. Apart from the surface sherds of predominantly Middle Wari styles, a relatively late establishment of most Wari centers at the *cabezadas*, after the height of the hyper-arid phase around 750 CE, would also make better sense if considering climate conditions. During Middle Wari, the whole study area formed part of the Wari Empire and was administered by foreign officials. But already at the end of the Middle Wari phase, probably around 850 CE, the Wari left the study area and hardly anyone remained.

The Wari rulers clearly had little interest in directly controlling irrigation agriculture at the foothills. Instead they focused on the *cabezadas*. The indifference towards the fertile floodplains would be logical if irrigation agriculture was little productive at that time, due to a shortage in reliably running irrigation water. Rainfall at the *cabezadas*, however, would also have been very sparse and consequently, rain-dependent highland farming should have been affected as well. If rain-fed farming was nevertheless extended, compared to the Late Nasca phase (as settlement patterns suggest) the phenomenon could be explained with the introduction of more sophisticated terrace-building techniques. These had been developed in the Ayacucho region by people associated with the Huarpa culture (Lumbreras 1974a:96-109) and were introduced in other areas during the expansion of the Wari realm. In the Chicha-Soras, Sondondo, and Negromayo (Andamarca) valleys, a boost in the construction of *andenes* is attributed to Wari rule (Aguirre-Morales Prouve 2009, Branch et al. 2007, Meddens & Branch 2010, Schreiber 1987/1992:149-151) and the same holds true for the case of Moquegua (Williams 2006).¹⁴⁶ The introduction of advanced terrace building techniques in the *cabezadas* of the NGD could also explain why Wari administrative facilities like S-1682 (Ayapampa), S-121 (Mauka Llaqta), and S-1723 (Santa María) were placed amidst such agricultural complexes. This explanation will nevertheless remain hypothetical unless more fieldwork focusing on terraces is carried out. The increase in pens associated with camelid herding could also point to an adaptation to dry conditions. Animals could be moved to less affected regions in case of droughts, whereas crops would wither on the fields.

The retreat of the Wari and the abandonment of the study area do not seem to have been directly related to worsening climate conditions which actually tended to improve at least slightly since the precipitation minimum around 750 CE. The Wari Empire was a complex, supra-regional phenomenon controlling territories in different parts of the Central Andes under highly diverse climate regimes. It also incorporated or interacted with many culturally and ethnically different peoples, each with its own particular interests, which were probably not always compatible with those of the empire. Accordingly, a variety of socio-political factors, including, rebellions and succession struggles, might have led to the breakdown of the Wari realm. Unfavorable climate possibly also was a factor, at least in some regions, but judging from the study area it was neither the single nor the principal one.

¹⁴⁶ *Andenes* are composed of multiple layers of pebble, gravel, and soil and can store moisture for a long time while also effectively draining excess water. In consequence, they can compensate for irregular precipitation patterns to a certain degree. Though most *andenes* still in use today are irrigated, many may originally have been rain-fed only.

7.8 Beginning Middle Ica Phase to the Spanish Conquest (1180 – 1532 CE)

The Late Intermediate Period was a restless time characterized by widespread warfare and the displacement of peoples in much of the Central Andes. Since the late 12th century CE, major waves of immigrants reoccupied the almost uninhabited study area. While at the *cabezadas* Rucanas settlers established new villages, the foothills were populated by groups culturally and probably ethnically related to the northern valleys of Ica, Pisco, and Chincha (see Chapter 7.1). The repopulation of the northern Río Grande drainage has to be seen in the context of a general situation of widespread and large-scale migration movements. When regarding the cultural differences, it appears unlikely that the Rucanas and the Nanasca shared the same geographic origin. Accordingly, the developments at the foothills and those at the *cabezadas* should be regarded separately.

It is still unclear where the Rucanas Laramati originally came from. Since their heartland lay in the headwaters of the Acarí river around the present-day town of Puquio (Abraham 2010, Schreiber 1993) the first guess would be that the settlers who populated the upper Río Grande drainage during the 13th and 14th century stemmed from that region. The area is located further inland than the *cabezadas* of the Río Grande drainage and receives greater amounts of rainfall. Accordingly, agriculture would have been less affected in times of drought. This reduced the probability that here as well depopulation occurred at the end of the Middle Horizon (Chapter 4.3.4).

Since archaeological studies are scarce in the Puquio area, it cannot be said with certainty if the Rucanas are the direct descendants of the local Middle Horizon population or if they came from elsewhere.¹⁴⁷ In any case, the Puquio district alone is much too small to explain a migration wave large enough to populate an area of at least twice its own size. It is more likely that the Rucanas people as a whole came from elsewhere, most probably from either further north (Ayacucho) or further south (Titicaca), sometime during the 12th century and then split into the Andamarcas and Laramati moieties which maintained close ties. In this scenario, the Andamarcas would have occupied the eastern *quechua*, namely the Sondondo valley and its tributaries, while the Laramati moved into the western *quechua*, but both branches may have merged with smaller groups of the respective local populations. The Andamarca colony of Uruguaci as well as three others in the Yauca valley (Julien 1993:199-203, Schreiber 1993) may be relatively late foundations, postdating the initial settlement, and were probably “established outside the Carhuarazo [Sondondo] Valley in order to gain access to goods not available locally” (Schreiber 1992:127). In this scenario, their founding would have followed the logic of the Andean ideal of complementarity.¹⁴⁸

Where the Nanasca, who reoccupied the foothills, came from is also unclear. A small local population may have managed to survive in the area itself during the Late Wari and Early Ica phases without leaving many traces. Additionally, the also small Late Horizon population of the SGD might have sent some settlers to the NGD. The large overall number of newcomers, however, could surely not have been recruited from the locals of the Río Grande drainage alone. Given the close cultural ties, the northern South Coast valleys of Chincha, Pisco, and especially Ica are the most likely places of origin, but the inhabitants of these valleys would probably not have left their homes without population pressure. Accordingly, there should be evidence for a substantial population at the end of the Middle Horizon and during the earliest phase of the LIP. Wallace, however, did not find “any ‘pure’ MIDDLE HORIZON site nor associated architecture” during his surveys (1972:3). In turn, later research revealed that several Wari-related settlements actually did exist in Pisco and Chincha (Alcalde Gonzales et al. 2001, Anders 1990, Santa Cruz Gamarra 2007), but these date to the Early and Middle Wari phases while no settlement is known (or has not yet been recognized or reported) that was definitely occupied during the *Late* Middle Horizon.

It would also be of great interest to know whether the *cabezadas* of the northern South Coast valleys were also abandoned at the end of the Middle Wari phase or if they remained occupied, but no data is available from this area. Given the high population density during the LIP, it can nevertheless be

¹⁴⁷ At Pulapuco, a settlement arguably identical with the Rucanas Laramati capital of Hatun Rucanas mentioned in colonial documents, Abraham (2010) found some disturbed Middle Horizon and Early Intermediate Period material below the LIP layers. Even if the site had been occupied continuously since the EIP, this does not necessarily mean that its successive inhabitants were direct descendants of the local population of the preceding period. Furthermore, a single site cannot be regarded as representative for a whole region.

¹⁴⁸ In Chapter 4.2 I pointed to the importance of assuring access to products from different ecozones. One possible strategy is sending out colonists to distant regions (Murra 1975c).

assumed that the northern valleys themselves experienced a major immigration wave, perhaps departing from the Central Coast or the Central Highlands, early in the LIP. The origin myth of the inhabitants of the Chincha valley, mentioned by Cieza de León, may support this assumption:

If one wants to know the origin of these indios of Chincha and from where they came to populate this valley, they say that, in past times, they set out in large numbers under the flag of a leader chosen by them, who dedicated himself very much to the service of their religions and who, with the good skills he possessed, was able to rally all of his folk in this valley of Chincha where they encountered many people. All of them had bodies so short that the tallest was a little taller than two cubits [ca. 84 cm (*codos comunes*) or 115 cm (*codos reales*)]. And, showing themselves reinforced while the natives were coward and timid, they vanquished them and won their realm. And they also affirmed that the surviving natives perished soon after, and that the grandparents of the parents who live today saw their bones in some tombs and these were as small as said. And as these indios had become the lords of the valley and as it was so fresh and offering abundance, they tell that they founded their villages at once. (2005 [1553]:201 (Chapter LXXIV))¹⁴⁹

There are obvious fantastic elements in this myth, particularly the statement that Chincha was inhabited by dwarfs, and the allegedly large numbers of these locals is also doubtful. Regardless, the story may represent a distant memory of a major migration movement and violent conquest that actually took place at the end of the Middle Horizon or the beginning of the LIP. After this event, a combination of ongoing immigration and natural population growth may soon have led to population pressure and the sending of colonists to more marginal valleys, namely to the Río Grande drainage. As the ecological conditions of the Río Grande drainage are basically the same as in the northern valleys, the foothills colonization was probably not so much motivated by the desire to gain access to different resources but by the need to supply an excess population with arable land. This would also explain why there seems to have been little obvious effort by the rulers of Ica and Chincha to control the Río Grande drainage politically: it had comparatively little economic value apart from subsistence production for its own population.

Unfortunately, the current state of research does not allow a reliable chronological subdivision of the LIP. As a consequence, it is impossible to identify changes in population density and settlement distribution and location between the time of the initial immigration and the Spanish Conquest. It is nevertheless obvious that at the height of the LIP, population levels reached an all-time high, even when considering the long duration of the Middle-Late Ica & Inca phase. To date, there is no evidence for a significant population decrease before the Spanish Conquest and especially before the civil war between the Pizarro and Almagro factions (1537-1542), which both recruited large numbers of indigenous fighters for their armies and devastated vast territories.

Contrary to the Ica and Chincha valleys, no integrated polity with an easily identifiable capital existed in the Río Grande drainage, neither at the foothills nor at the *cabezas*. Apparently, the larger settlements were autonomous in both areas. Perhaps, the Nanasca as well as the Rucanas formed a confederation in case of external threats but they were also competing among themselves. Numerous examples of fortifications, sling stone caches, and the often clearly defensive locations of settlements leave no doubt that warfare and violence occurred frequently, though it is not known who fought whom, nor when, nor why. Political fragmentation and warfare between neighboring communities ended with the incorporation of the South Coast into the Inca Empire.

Climate Impacts

The extremely high population density in the study area during the height of the Middle-Late Ica & Inca phase required an optimum of agricultural production, which in turn suggests abundant and reliable rainfall feeding the highland terraces and providing irrigation water in quantities sufficient for the cultivation of practically the complete area of the valley floors plus some small lateral quebradas. Geoarchives, however, indicate that climate was not that favorable throughout the approximately 500 years of the LIP. Immigration to the NGD may have started at least several decades before the late

¹⁴⁹ My translation. Original reads: "Queriendo saber el origen de estos indios de Chincha, y de donde vinieron a poblar en este valle, dicen que cantidad de ellos salieron en los tiempos pasados debajo de la bandera de un capitán esforzado de ellos mismos, el cual era muy dado al servicio de sus religiones y que con buena maña que tuvo pudo allegar con toda su gente a este valle de Chincha, adonde hallaron mucha gente y todos tan pequeños cuerpos que el mayor tenía poco más de dos codos, y que mostrándose esforzados, y estos naturales cobardes y tímidos, les tomaron y ganaron su señorío. Y afirmaron más, que todos los naturales que quedaron se fueron consumiendo, y que los abuelos de los padres que hoy son vivos vieron en algunas sepulturas los huesos suyos, y ser tan pequeños como está dicho. Y como estos indios así quedasen por señores del valle, y fuese tan fresco y abundante, cuentan que hicieron sus pueblos concertados."

12th century CE, when climate was still relatively dry. As already stated for the Initial Nasca phase, it appears that even under hyper-arid to arid conditions, irrigation water was nevertheless available in sufficient quantities for the cultivation of at least a larger part of the valley floors.

Later on, a climate optimum from approximately 1250-1450 CE enabled the highest population density of all times. The improved conditions for both rain-fed and irrigation agriculture may have motivated the immigration of the Rucanas Laramati into the *cabezadas* and the occupation of the foothills by the Nanasca, a different group of foreigners probably stemming from the northern South Coast valleys. Since the Pisco and Chincha rivers carry significantly more water than the Río Grande and its tributaries, shortages in irrigation water were probably much less common there, even under hyper-arid conditions. Accordingly, it is very possible that the respective valleys were the destination of a major wave of immigrants – perhaps coming from the Central Highlands – already early in the LIP, when conditions in the Río Grande drainage were still relatively hostile. In Ica, the hydrological resources are lower than in the Río Grande drainage as a whole but higher than in any of the individual tributaries. The population density there may have exceeded that of the NGD during the early part of the LIP, but a major population boost did probably not occur before the mid-13th century CE. Unfortunately, the published data available from the Ica valley is still too incomplete to either support or reject this hypothesis.

Most geoarchives from the Palpa area itself, as well as from distant regions, suggest a return to near hyper-arid conditions by the mid-15th century. Surprisingly, however, the archaeological record does not seem to imply notable depopulation before the Spanish Conquest. Some caution is advisable, though, due to the paucity of numeric dates from LIP settlements and the difficulties in distinguishing sub-phases in style development. It is possible that many of the villages without Inca or Inca-influenced ceramics or constructions were indeed already abandoned before the incorporation of the South Coast into the Empire either around 1440 or in the early 1470s CE (see Chapter 3.2.4.5). If the assumption is correct that most major settlements were not established or significantly enlarged before approximately 1250 CE, then the relatively short occupation span of only some 200 years would explain why almost no major stylistic changes can be observed in the ceramic assemblages. On the other hand, there is no indication of a dramatic climate change in colonial documents, although a severe crisis caused by permanently decreased precipitation would surely still have been present in the collective memory of the affected peoples a hundred years later. Instead, Cieza states that the valleys of the Río Grande drainage were “densely populated” (“muy poblados”) before the Pizarro-Almagro wars of the late 1530s (Cieza de León & Pease 2005 [1553]:204 (Chapter LXXV). Since he did not know how the situation was prior to the Incaic expansion, it is nevertheless possible that population density had already decreased, compared to the early 15th century.

Further archaeological and paleo-climatological research concentrating on the time span from 1000-1550 CE is necessary for a better understanding of what happened during that period culturally and climatically before statements about causal links between both phenomena can be made with greater confidence. The LIP is a key period not only because archaeological remains are preserved more completely than in case of previous periods but also and especially because these can be complemented with ethnohistoric sources. Accordingly, the chance of being able to move away from weighing patchy evidence to actually either proving or disproving a direct causal linkage between population density and climate change is highest for the centuries before the arrival of the *conquistadores*. If it turns out that population levels remained very high although geoarchives point to near hyper-arid and highly variable climatic conditions, then it becomes questionable if climate ever triggered major changes in settlement behavior in the NGD during the time span addressed in this study. But if a close correlation between population development and precipitation levels can be demonstrated, there is every reason to assume that a causal link existed in the more distant past as well.

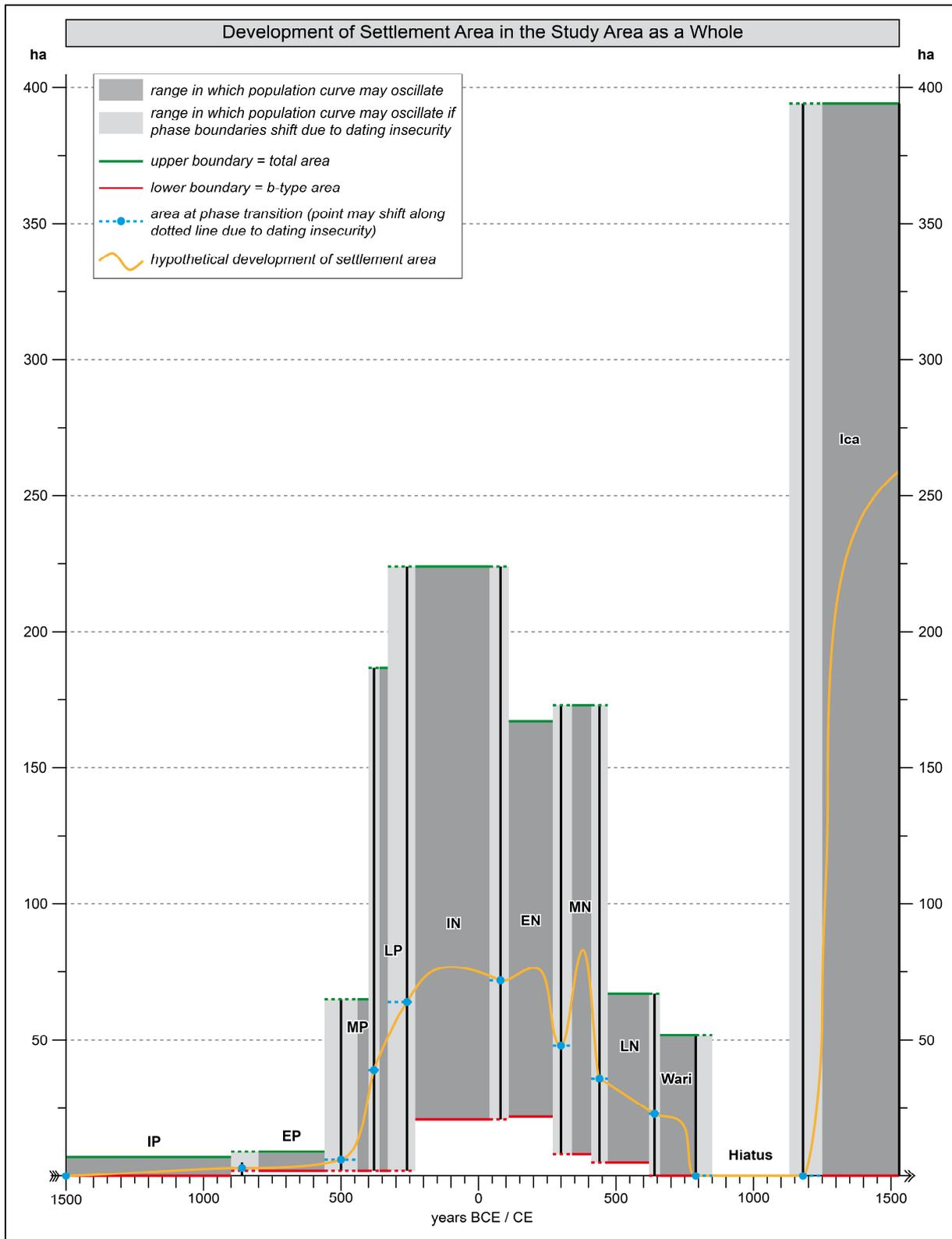


Figure 119: Hypothetical reconstruction of the development of the simultaneously occupied settlement area between 1500 BCE-1532 CE. It is assumed that the area is roughly proportional to population size. Graphic: VS.

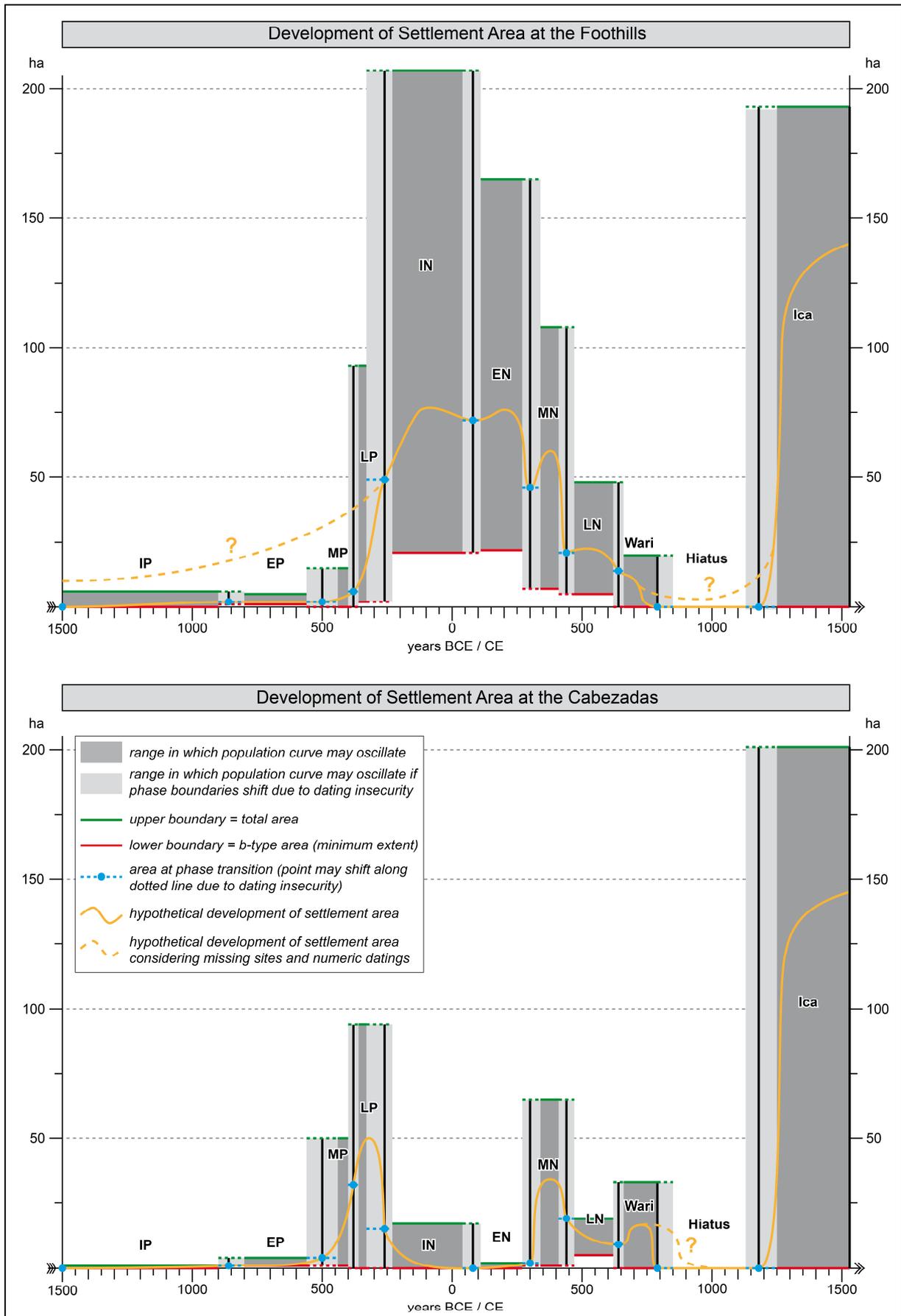


Figure 120: Comparison of the development of settlement area at the foothills and at the cabezadas. Graphic: VS.

8 Conclusions: The Impact of Climate Change on Settlement Behavior

The present study aims to assess the impact of climate variability on pre-Hispanic (1500 BCE-1532 CE) settlement behavior and general cultural development in the northern Río Grande de Nasca drainage (South Peru, 14.5°S). The study area is located in an arid environment comprising all altitudinal steps of the Andean west flank from the foothills starting at 300 m.a.s.l. up to the water divide at 4000-4500 m.a.s.l. It comprises the valleys of the Río Grande, Palpa, and Viscas rivers as well as the areas between. In this region, already slight absolute variations in climatic parameters have a significant impact on the availability of the resources crucial for human subsistence. This is especially true for precipitation which increases with altitude, and temperature which decreases with altitude. Both factors can cause reduction of agricultural production in the case of drought and frost. As a consequence, fluctuations of these climatic parameters have repeatedly been proposed to have either challenged or favored human subsistence and to have thereby triggered major cultural developments in the region.

By a diachronic analysis of settlement patterns, variations in population levels, political organization, intensity of conflicts, and land use were identified. Were these major changes in settlement behavior indeed caused by climate change? The results of the analysis of archaeological data were compared to a reconstruction of the paleo-climate based on published data from geomorphological and sediment studies in the study area itself and in remote regions. Since no published data is currently available that reflects changes in temperature patterns, paleo-climate reconstruction focuses on precipitation. During the last 3500 years, the climate around the town of Palpa (350 m.a.s.l.) shifted between hyper-arid and near semi-arid. Conditions in the highlands were always moister in relative terms, following a non-linear, altitude-dependent precipitation gradient. Rainfall in this area feeds the rivers that cross the desertic foothills, creating fertile valley oases.

During most epochs, cultural development at the foothills differed from that in the highland section (above approximately 2000 m.a.s.l.) of the study area, which is known as the *cabezadas*. Marked differences in architectural traditions and settlement layout suggest that the inhabitants of both regions did not share the same culture or ethnicity, even though interaction between them was intense. Between the start of the Initial Period and the start of the Middle Paracas phase (1500 – 450 BCE), population density and social complexity were low and cultural development was smooth. Stylistically, after 800 BCE local traits were complemented by iconographic elements from the north associated with the Chavín and Cupisnique styles but a general change in settlement behavior and socio-political organization cannot be deduced from the archaeological record. No settlements of these phases are known from the *cabezadas* so far. An important concentration of villages can be observed in the Collanco section of the upper Palpa valley. The apparent paucity of sites at the foothills may be explained by the covering or destruction of villages located at the valley floors due to intense agriculture in later phases.

Arguably during the late 5th century BCE, towards the end of the Middle Paracas phase, a process suddenly started which triggered profound changes in culture, demography, social structure, and political relations. It was characterized by a massive immigration of foreigners – probably originating from regions east of the water divide – into the *cabezadas* section of the study area, a decrease of stylistic influences from the north (Cupisnique/Chavín), and a sharp increase in violent conflict. With regard to economy, the newcomers probably introduced camelid herding in the study area.

At the end of the Late Paracas phase and during the earlier part of the Initial Nasca phase (300-100 BCE) many *cabezadas* settlements were abandoned and their inhabitants left the study area. At the same time, population density at the foothills increased dramatically. Since settlement layout and architectural traditions were clearly different from those at the highlands, it is unlikely that the *cabezadas* population moved into the middle and lower valleys. It is more probable that groups from the northern South Coast valleys, especially from the Ica valley, immigrated into the Palpa region. At the same time, a stylistic influence known as Topará becomes evident. This style is believed to have originally developed in the Cañete, Chíncha, and Pisco valleys, but little research has focused on this subject and a detailed style definition has not yet been presented. In the study area, Topará material does not occur in discrete contexts but is mixed with, or cannot be distinguished from, local wares. Apart from stylistic influences, new burial customs were introduced. Furthermore, settlement patterns

suggest the emergence of a settlement hierarchy that indicates an increase of social complexity and the beginning of political integration on a local level.

Since the latter part of the Initial Nasca phase, starting around 100 BCE, the manifold and highly dynamic social, political, and demographic processes lead to the formation and consolidation of a new cultural tradition: Nasca. Burial customs and decorative styles become more uniform and political integration expanded. During the Early Nasca phase, settlement patterns support the assumption that a unified and drainage-wide polity existed whose capital was the great temple city of Cahuachi in the Nasca valley. Local centers, such as Los Molinos and Llipata in the study area, were probably subordinate to Cahuachi. The *cabezadas* were almost completely uninhabited while settlement density at the foothills remained high. Towards the end of the Early Nasca phase, around 300 CE, Nasca society experienced a sudden collapse, according to the definition proposed by Joseph Tainter (1988). Cahuachi and many related local centers were abandoned, the drainage-wide polity dissolved, and population decreased by at least a third.

Nasca society nevertheless seems to have reorganized soon and recovered rapidly. At the height of the Middle Nasca phase, around 400 CE, population levels may have reached almost those of the previous phase. The drainage-wide political integration was not restored, however, and power was concentrated in the hands of local lords, each controlling a valley or a larger valley section. Judging from their rich graves, at least some of them were astonishingly wealthy.

In addition to these foothills polities, the *cabezadas* were reoccupied at a scale comparable to the Middle and Late Paracas phases. The places chosen for settlements were often the same, and even the architecture shows some similarities. Again, the number of newly established settlements and the architectural differences to the ones at the foothills suggests immigration from outside the study area. The newly arrived *cabezadas* population may have catalyzed economic and cultural exchange with the Ayacucho region, which becomes especially evident in the archaeological record of the Late Nasca and Early Wari phases (450-750 CE) when first Huarpa and later Wari influence is recognizable in ceramic styles and architecture.¹⁵⁰

The Middle Nasca recovery was surprisingly short-lived, compared to earlier and later cultural developments. Towards the end of the phase, during the early 5th century CE, population levels went down again, both at the foothills and at the *cabezadas*. While the remaining highlanders concentrated in some already existing large settlements, in the lower sections of the study area the focus of settlement shifted to the middle and upper valleys and the most important centers were abandoned. This demographic and socio-political disruption was apparently not accompanied by a significant increase in conflict. During the following Late Nasca phase, new centers of power emerged at the foothills, e.g., Parasmamarca, but population levels stayed low. At the end of the phase, only the middle Río Grande valley was still settled relatively densely. At the *cabezadas*, only four settlements remained. At this time, mutual cultural influence between the Nasca and the Ayacucho regions intensified, and some immigrants from Ayacucho probably moved into the study area. During the early Middle Horizon (2nd half of the 7th century CE), the intense contact more and more turned into economic and political dependence of the Nasca region from the Wari heartland (Ayacucho).

Reconstructing the developments during the Middle Horizon (650-1000 CE) proved especially difficult because of the limited number of numeric dates and the paucity of diagnostic surface material. This period is characterized by the expansion of Wari presence in much of the Central Andes. Settlements at the foothills are mostly associated with sherds of early Middle Horizon styles, especially of the local variant called "Loro." At many *cabezadas* settlements, in turn, surface material, but also typical architecture from the later Middle Horizon 2 phase was found. It has to be cautioned, however, that style chronologies for this period are not definitely fixed and may have to be redefined in the light of ongoing and future research. If the current chronology proves correct, two largely successive and only partly overlapping processes may have occurred in the study area. During the 8th century CE, the foothills may have been depopulated almost completely while probably not before the late 8th century, the Wari Empire established several administrative centers at the *cabezadas*. By that time, the entire Río Grande drainage should have been under formal Wari control, but direct administration and agricultural production seems to have focused on the *cabezadas*. Only shortly later, probably by the mid-9th century CE, virtually all known settlements were abandoned. Although it is likely that a few so far undetected small and simple hamlets continued to exist, population levels must have been extremely low for a long time (until the late 12th century).

¹⁵⁰ Huarpa and Wari are the local cultures of the Ayacucho region during the Early Intermediate Period (100 BCE-650 CE) and the Middle Horizon (650-1000 CE), respectively.

Since the late 12th century CE, the study area was suddenly repopulated by large groups of immigrants. From written colonial sources it is known that the *cabezadas* were settled by the Rucanas and the foothills by the Nanasca. Both peoples established especially large and often fortified towns following their respective architectural traditions. Although often being of considerable size, these population centers show little architecture that could be interpreted as public, ceremonial, or administrative. Apparently, neither group was organized as a centralized polity. The larger settlements seem to have been largely autonomous but may have formed a confederacy in times of external threats. Settlement patterns clearly show an unsettled buffer zone between Rucanas and Nanasca, and fortifications and sling stone caches indicate frequent violent conflicts. It is nevertheless unlikely that these conflicts were predominantly interethnic in character, given the economic interdependence between foothills and *cabezadas* groups, but may rather reflect competition between direct neighbors belonging to the same people.

Population probably peaked during the 14th and 15th century CE. At this time, the study area reached its highest population density ever, including the present. As a consequence, almost every possible patch of land was irrigated or terraced and brought under cultivation, including extremely steep slopes (more than 40°). Either around 1440 or 1470 CE, the Río Grande de Nasca drainage was incorporated peacefully into the Inca Empire. The Inca built administrative complexes in the foothill sections of each valley and added some structures to several existing Nanasca and Rucanas settlements, but their presence was nevertheless limited. They seem to have ruled indirectly through allied local elites. For most local commoners, daily life does not seem to have changed much, neither at the foothills nor at the *cabezadas*. During Inca rule, small-scale internal conflicts ceased and newly established settlements or added dwelling sectors were no longer fortified. In 1532, the Spanish invasion triggered the fall of the Inca Empire. According to the early Spanish chronicler Pedro Cieza de León, the Río Grande drainage was still densely populated at that time but suffered heavy population losses during the wars between different factions of the Spanish conquerors and their respective native allies (1537-1542 CE). Since he did not know the situation in the pre-Inca period, it is nevertheless possible that demographic development had already turned negative before the Spaniards arrived.

This reconstruction of cultural development based on archaeological data was compared to studies on paleo-climate to check for temporal correlations between significant changes in climate and major shifts in settlement patterns and population levels. The following paragraphs summarize the reconstruction of paleo-climatic developments drawing on studies by different research groups which cooperated with the Palpa Project during the past ten years (Eitel et al. 2005, Eitel & Mächtle 2009, Hesse & Baade 2007/2009, Mächtle 2007, Mächtle & Eitel 2009/2013, Mächtle et al. 2006/2010, Schitteck et al. 2012, Unkel & Kadereit et al. 2007).

Before 1000 BCE, evidence for loess erosion signals a lacking vegetation cover suggesting prevailing arid or even hyper-arid conditions at the foothills. At the same time the formation of first irrigated anthrosols in some sections of the valley floors indicate early irrigation agriculture in the river oasis. During the following centuries until at least 700 CE, the cultivated area was extended and probably irrigated without major interruptions. This would be evidence for the continuous availability of irrigation water in sufficient quantities, even though precipitation at the headwaters of the rivers had varied. Such variations cannot be deduced directly from local geoarchives, so far, but are suggested by studies of remote archives. From 1000-650 BCE, conditions may have been near semi-arid, except for a short hyper-arid phase in the early 9th century BCE. Thereafter, climate was probably variable until 450 BCE. Starting then, more or less stable arid conditions probably prevailed for almost a thousand years, until 500 CE. Only in the early 3rd and the early 1st century BCE, average annual precipitation may have slightly decreased.

From 660-770 CE, several local geoarchives provide evidence for occasional flash flooding caused by rare torrential rainfalls. This phase of relative instability preceded a longer period of increased aridity, which lasted at least until 1250 CE. Remote archives suggest that it may have been interrupted by moister conditions during the 10th and early 11th century CE. Local evidence supporting this scenario has not been found. Both local and remote records testify to the prevalence of a stable and near semi-arid climate between the late 13th and the early 15th century. Since 1440 CE, however, precipitation seems to have become highly variable and climate tended to return towards hyper-aridity.

Conclusions concerning the impact of climate variability on settlement behavior and population levels can be drawn by juxtaposing the reconstructions for both these kinds of phenomena. Figure 121, showing the developments in culture, population levels, and average annual precipitation on a time scale, illustrates the following statements.

If climate before 1000 BCE was indeed highly volatile and tended to hyper-aridity it is nevertheless unlikely that these unfavorable conditions caused serious problems for the inhabitants of the study area. In this early epoch, people were still few in number and would only have used a fraction of the potentially available agricultural resources. They would accordingly have remained unaffected by a reduction of these resources. After 1000 BCE, a favorable climate may have enabled the initial occupation of the Collanco area where rain-fed agriculture was practiced at an altitude as low as 1600 m.a.s.l. This would not have been possible under arid or even hyper-arid conditions. The return of a more variable climate from 650-450 BCE may therefore have caused a temporary abandonment of the area. Unfortunately, the resolution of the archaeological data does not suffice to indicate clearly whether this was actually the case.

Climate seems to have been arid and stable from 400-200 BCE and possibly even slightly more favorable during the late 5th century BCE. This situation may have attracted the settlers who occupied the *cabezadas*. The abandonment of that area, in turn, does not correlate with significant changes in precipitation levels and, since the few remaining villages were located at relatively high altitudes, it is also unlikely that a substantial drop of temperatures threatened the local subsistence economy. The immigration into the foothills may at least indirectly be linked to the Topará phenomenon, which is not related in any recognizable way to climate change and should be regarded as a purely social and cultural development.

Throughout the late Initial and Early Nasca phases, geoarchives suggest sufficient and reliable precipitation in the study area. As a consequence, irrigation agriculture at the foothills should have been highly productive and surely supported the social, political, and cultural developments. Since comparable conditions had already prevailed during the preceding centuries, climate may nevertheless only be regarded as a supporting factor but not as a trigger. When the collapse at the end of Early Nasca occurred, precipitation patterns had not changed significantly. Accordingly, climatic fluctuations can be ruled out as an underlying cause for this phenomenon. Once again, socio-political events seem to have been the major driving forces.

The impact of climate change on the developments during the Middle and Late Nasca phases was probably low, if any at all. The decrease of population at the end of the Middle Nasca phase occurred at a time when precipitation probably increased. After a possible near hyper-arid phase during the early 6th century favorable conditions returned for another 100-150 years, but population in the northern Río Grande drainage did not recover. Accordingly, socio-political factors are more likely to have caused depopulation and the fading of the Nasca culture.

There is good reason to assume that the final abandonment of the foothills was related to a lack of irrigation water due to decreased precipitation at the headwaters, since the 8th century was probably one of the driest phases of the last four millennia. For the same reason, it is also likely that the majority of the Wari installations at the *cabezadas* were not established before the late 8th century, when conditions were slightly improving. It is nevertheless interesting to note that under the still near hyper-arid conditions (at the foothills), rain-fed agriculture and camelid herding at the *cabezadas* must have been attractive to the Wari, considering their investment in building activity. The introduction of improved terrace systems may have been crucial for effective land use in a relatively dry area. If a return to favorable near semi-arid conditions from 900-1050 CE, as suggested by the records of several remote geoarchives, indeed occurred, it did not trigger resettlement. After approximately 1050 CE, climate became near hyper-arid again for at least another 200 years.

While the arrival of the first waves of Rucanas and Nanasca settlers probably fell within a phase of near hyper-arid conditions from 1050-1250 CE, the particularly favorable and near semi-arid climate during the following two centuries should have assured maximal agricultural productivity and allowed for very high population levels. Contrastingly, the return of near hyper-arid conditions since 1440 CE will have reduced food production. As a consequence an emigration wave would be expectable. Nonetheless, neither the settlement data nor early colonial written sources clearly indicate such a development. Since Inca-style or Inca-influenced ceramic sherds are rare in Nanasca and Rucanas settlements and local styles stayed in use more or less unchanged until the Spanish Conquest, it is almost impossible to distinguish settlements abandoned during the late 15th century from those which continued to be occupied. Accordingly, it is conceivable that settlement density indeed decreased. It would nevertheless be surprising that such an important and potentially traumatic event had already been completely forgotten a century later. But if it was well remembered, then it remains to be explained why the Spanish chroniclers did not make any remark about native oral traditions referring to a great famine.

In sum, regarding the entire cultural sequence from 1500 BCE-1532 CE, temporal correlations between significant changes in climate and major cultural developments are rare. In some cases the archaeological data in general and the settlement patterns in particular suggest high population levels and cultural heydays in phases of increased aridity while drastic population decline and the dissolution of polities can also be observed under comparatively favorable climatic conditions. Accordingly, a direct causal link between both kinds of phenomena is unlikely during most of the time frame relevant to this study.

It has to be cautioned, however, that the temporal resolution of most geoarchives studied by the paleo-climatologists is low and that major climatic events can often only be dated with a margin of error exceeding ± 100 years. There are also uncertainties in interpreting the archaeological record. While ^{14}C -dates are numerous and reliable, the samples are not equally representative for all cultural phases and for the entire study area. The relative chronology predominantly relying on the seriation of ceramic styles is also insufficient for certain periods, especially for the Late Intermediate Period. These potential sources of error hamper the reconstruction of past human-environmental relationships and may have led to a partial misinterpretation of either the archaeological or the climatological data, or both.

Only additional, high-resolution data can clarify whether correlations were actually stronger and more frequent than it has been concluded here. If the results of the present study were confirmed this would still not mean that climate had no impact at all. It certainly had, but its fluctuations only rarely jeopardized a society or triggered a cultural heyday. As long as climate did not turn hyper-arid, precipitation seems to have been sufficient to enable rain-fed terrace farming at the *cabezadas* and to irrigate the lower valley floors with the water of the rivers running from the highlands.

Full-blown hyper-aridity over a period of at least several decades probably only occurred during the later part of the Initial Period (11th and early 9th century BCE) and again during the Middle Horizon (8th century CE). Since in both cases population density had already been low before it is unlikely that the availability of water for agricultural production was reduced to a degree where major crop failures and wide-spread famine would have resulted. During all other phases, climate will still have had an impact in a way that especially favorable (stable arid or near semi-arid) conditions additionally supported cultural and socio-political developments or encouraged immigration while less favorable (variable and near hyper-arid) conditions may have exacerbated socio-political crises and stimulated emigration. Interaction with regions neighboring the study area nevertheless seems to have had the greater effect on population exchange, economy, politics and conflict, and general cultural development.

Outlook and Proposals for Future Research

The present study should be considered part of an extended research network. It profited very much from the pioneering works of other scholars directly involved in or associated with the Palpa Project and will hopefully likewise be of help for current and forthcoming studies. The very large amount of archaeological data available allowed for a detailed analysis and an in-depth discussion of settlement patterns and general cultural development. Many resulting conclusions nevertheless remain tentative until data gaps are filled by future studies. This is especially true for the reconstruction of migration movements, which requires comparison with data from neighboring regions where archaeological studies are often either very limited or poorly published. In the study area itself, many detailed excavations have taken place so far, but still there is some imbalance regarding the diverse cultural phases and the geographic distribution. Namely, settlement sites dating to the Late Intermediate Period (LIP, 1000-1470 CE) have received comparatively little attention as have Early Intermediate Period (100 BCE-650 CE) settlements at the *cabezadas*.

The LIP is a key period because it offers the greatest potential for multi-disciplinary research. The archaeological record is the best preserved but surprisingly also the least investigated. Additionally, several colonial documents contain information that would be impossible to gather by excavation alone, for example, the names of important persons and places and the relations between them. The results of Mareike Mölders' current PhD project can be expected to enable new insights gained from the analysis of ethnohistoric sources. Besides cultural development, the evidence for climate change also seems to be more detailed and less ambiguous for the last 500 years before the Spanish Conquest. Accordingly, the LIP clearly is the period for which human-environmental relationships can be reconstructed with the greatest confidence and the highest level of detail. If these centuries were well

understood, it would probably also be easier to interpret the much more fragmentary record of earlier periods.

This is also true for the transitions from the Paracas to the Nasca culture (300 BCE-100 CE), which marks an especially dynamic and far-reaching cultural change. For this reason, the respective period is the current research focus of the Palpa Project. Ceramic analyses in the scope of the PhD projects of Heike Otten and Daniela Östreich, the MA study on super-regional comparisons of architectural features by Emilia Schmidt, and the PhD research of Christian Mader on economy will help to clarify the relations between groups settling at the coast and at the foothills with those dwelling at the *cabezadas*. They may also shed light on far-distance relations. The initial settlement of the study area and the concomitant cultural and environmental circumstances constitute the prelude for the developments discussed in this study and are being investigated in the scope of the PhD project of Hermann Gorbahn, who takes the archaic settlement of Pernil Alto as an example. There still is a data gap between the latest occupation of this site (around 3000 BCE) and the earliest one of the Initial Period (1500-840 BCE) which will hopefully be filled soon by new research.

At all times, agricultural production was very important, but economic exchange with distant regions may have focused on rare and valuable luxury goods rather than on food. This aspect has not been treated prominently in the present study, but since it is also related to stylistic and other cultural influences, it surely deserves attention. Mining has been practiced in the study area for millennia and metals may have been an important trade good. The exploitation of mineral pigments for the painting and dyeing of vessels and textiles was also practiced. Pre-Hispanic mining and quarrying in the study area and in neighboring regions is the subject of a current PhD project of Benedikt Gräfinholt that will provide new insights into this complex matter.

The reconstruction of paleo-climate will also need refinement, especially regarding the amplitude of major changes and the numeric age control of the periods prior to 600 CE. More local high-resolution data is desirable. Furthermore, the impact of temperature fluctuations on the upper limits of rain-fed *cabezadas* agriculture deserves to be investigated in detail. The ongoing analysis of drill cores from the Atocata cushion peatland by Karsten Schittek and Markus Forbriger from Cologne University may soon shed new light on this important issue.

An especially interesting and promising field of research is agricultural terraces. If it proved possible to reliably date both the time of initial construction and the periods of use and re-use, terraces would be ideal markers for shifts of the lower boundaries of rain-fed farming. There are many terraces in marginal areas, especially in some larger quebradas such as the Quebrada Camajayoc, which are well preserved and largely untouched by recent cultivation. These would be an ideal starting point for a new project focusing on pre-Hispanic land use and its potential as a proxy for precipitation development. Likewise, *puna* terraces may indicate the periods during which the minimal temperatures during the growing season were generally above 0°C even at altitudes exceeding 4000 m.a.s.l. Additionally, terraces may contain information on the state of technology (irrigation, drainage, moisture management, use of fertilizers). The ongoing PhD projects of Fernando Leceta on agricultural soils and of Pablo Jimenez on early water management will be pioneering studies in this field for the study area and beyond.

Exciting new results from all the mentioned studies will be available soon. Since these will surely boost our understanding of culture and nature in the pre-Hispanic era, I look forward to comparing them to the conclusions of this thesis.

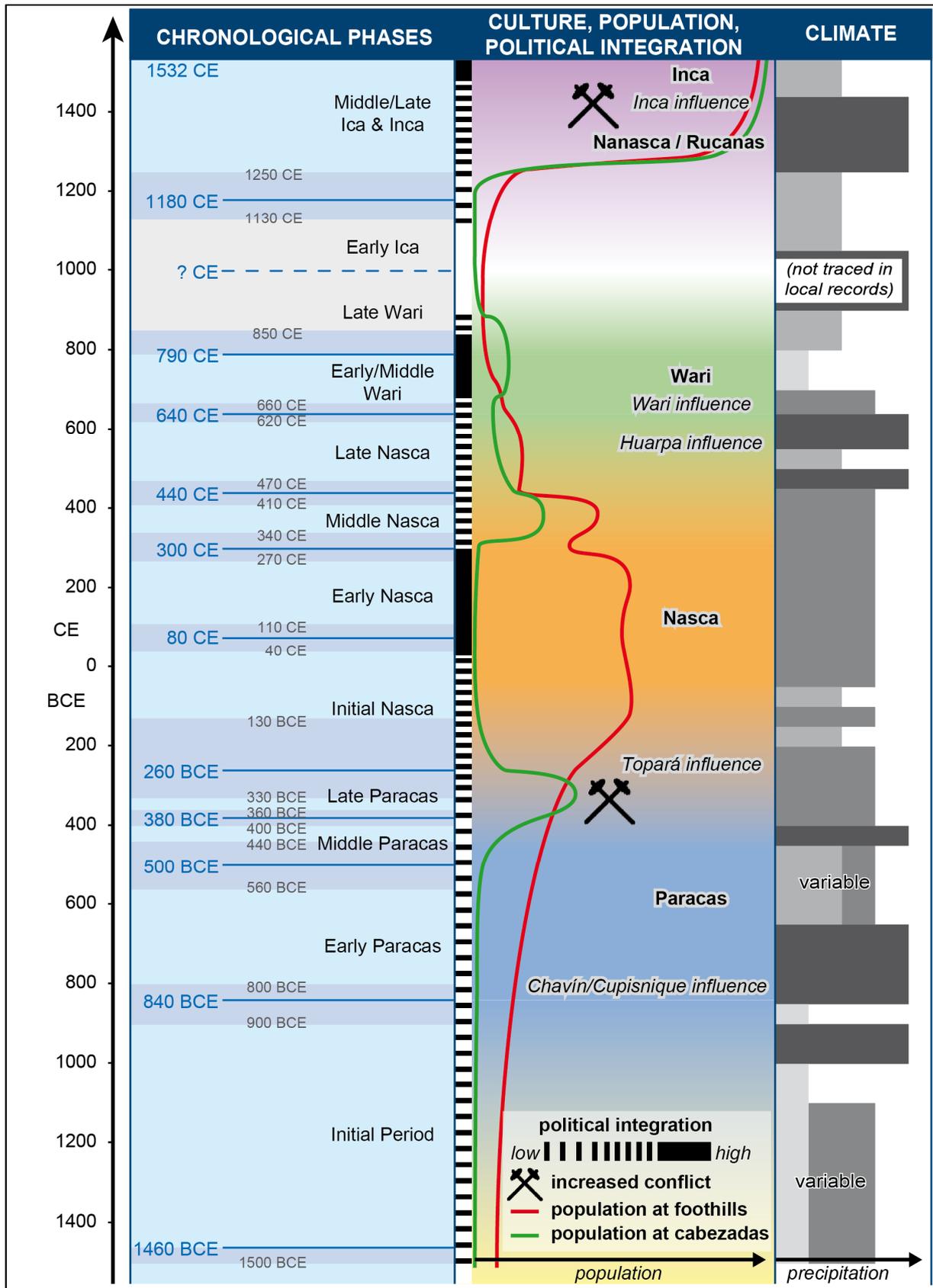


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Glossary: Terms of Spanish and Quechua Origin

<i>Adobe</i>	Unfired mud bricks
<i>Altiplano</i>	A vast high-altitude plain located in the south-Peruvian and Bolivian Andes
<i>Andenes</i>	Sophisticated agricultural terraces, usually irrigated, composed of several layers of pebble, gravel, and soil.
<i>Barbacoa</i>	Roof for an elaborate tomb of parallel tree trunks, reminiscent of a grill
<i>Cabezadas</i>	The headwater area of the coastal rivers
<i>Chala</i>	The coastal strip of Peru
<i>Chullpa</i>	Round aboveground burial stone house common at the <i>cabezadas</i> and in the upper valleys during the Late Intermediate Period
<i>Conquistadores</i>	Europeans, especially Spanish, involved in the conquest of Central and South America
<i>Corregidor</i>	Spanish Official entrusted with the administration of a rural district
<i>Huaca</i>	A sacred place or item. The term is often used for temple mounds
<i>Huarango</i>	Local name for the porknut tree (<i>Acacia macracantha</i>) which is common at the Peruvian coast and provides edible husks and timber
<i>Janca</i>	Andean Mountain peaks above 4800 m.a.s.l.
<i>Kunti</i>	Rectangular above-ground burial stone houses common at the <i>cabezadas</i> and in the upper valleys during the Middle Horizon
<i>Lomas</i>	Coastal hills and Andean foothills at which fog accumulates on the seaward side during austral winter (May-October), allowing a lush seasonal vegetation
<i>Omagua</i>	The Peruvian part of the Amazonian lowlands below 400 m.a.s.l.
<i>Pampa</i>	Plain
<i>Páramo</i>	Cold, humid highlands above the tree line at roughly 3200-3700 m.a.s.l., common in the northern half of the Central Andes
<i>Pirka</i>	Drystone masonry of unworked field stone
<i>Puna</i>	Andean highlands above approximately 4000 m.a.s.l.
<i>Puquio</i>	Artificial filtration galleries and associated wells built during the Nasca Period
<i>Quebrada</i>	Dry valley
<i>Quechua</i>	Upper valley sections and slopes between approximately 2300-3800 m.a.s.l.
<i>Quincha</i>	A light wattle-and-daub construction technique common in coastal Peru
<i>Reducción</i>	Village established by the Spanish colonial government after 1570 CE in order to gather and control the surviving indigenous population living in dispersed hamlets
<i>Rupa rupa</i>	Wet forest at the Central Andean east flank between 400-1000 m.a.s.l.
<i>Selva</i>	Region largely covered by tropical forest comprising the lower reaches of the Andean east flank and the Amazonian lowlands
<i>Suni</i>	The terrain at both flank of the Central Andes between 3500-4000 m.a.s.l.
<i>Tampu</i>	A kind of caravanserai and storage facility placed along the Inca road network. The more important <i>tampus</i> also served as seats of the provincial administration
<i>Tapia</i>	Large blocks of rammed clay
<i>Yunga</i>	The foothills and the lower and middle valley sections at the Central Andean west flank between 500-2300 m.a.s.l.

List of Abbreviations

aDNA	Ancient Deoxyribonucleic Acid (an organic molecule holding the genetic information about an organism that died long ago. Of special interest for archaeology are remains of humans and domestic animals)
AMS	Accelerated Mass Spectrometer (an instrument used for the measurement of ¹⁴ C contents in organic material through separating accelerated isotopes by their mass)
AMMTGS	Average Monthly Minimum Temperature during Growing Season (the multi-year average value of the monthly minimum temperatures from January to May. Where it drops below 0°C, crops may be severely damaged by nightly frosts)
ASTER	Advanced Space-born Thermal Emission and Reflection Radiometer (provides imagery and DEMs of the Earth's surface)
BCE	Before Common Era (age indication, identical to <i>Before Christ</i> (BC))
CE	Common Era (age indication, identical to <i>Anno Domini</i> (AD))
DEM	Digital Elevation Model (a geocoded raster with cell values representing surface elevations)
EH	Early Horizon (a period in Central Andean prehistory with widespread influences of the Chavín style, approximately 900-200 BCE with regional deviations)
EIP	Early Intermediate Period (a period in Central Andean prehistory with regionally diverse cultural and political developments, approximately 200-600 BCE with regional deviations)
ENSO	El Niño – Southern Oscillation (climatic phenomenon describing the abnormal weakening or even inversion of the direction of air and ocean currents, especially in the Pacific region)
FAO	Food and Agriculture Organization (an entity of the United Nations)
INRENA	Instituto Nacional de Recursos Naturales (a division of the Peruvian Agriculture Ministry, in many respects keeping up the work of ONERN (see below))
IP	Initial Period (a period in Central Andean prehistory beginning with the introduction of pottery around 1500 BCE and ending with the spread of the Chavín style, approximately 900-200 BCE with regional deviations)
ITCZ	Intertropical Convergence Zone (a belt of cyclones close to the equator where air and water are heated by nearly vertical solar radiation)
m.a.s.l.	Meters above sea level
MH	Middle Horizon (a period in Central Andean prehistory with widespread influences of the Wari style and the Wari Empire, approximately 600-1000 CE with regional deviations)
LH	Late Horizon (a period in Central Andean prehistory with widespread influences of the Inca style and the Inca Empire, approximately 1470-1532 CE with regional deviations)
LIA	Little Ice Age (a period of relatively cold conditions on a global level between approximately 1550 and 1850 CE)
LIP	Late Intermediate Period (a period in Central Andean prehistory with regionally diverse cultural and political developments, approximately 1000-1470 BCE with regional deviations)
NGD	Northern Río Grande drainage (the valleys of the Santa Cruz, Grande, Palpa, Viscas, and Ingenio rivers)
ONERN	Oficina Nacional de Evaluación de Recursos Naturales (a Peruvian authority entrusted with the analyses and registration of land use, related problems, possible solutions, and unused potentials during the 1960s and 1970s)
SGD	Southern Río Grande drainage (the valleys of the Aja, Tierras Blancas, Nasca, Taruga, and Las Trancas rivers)
SRTM	Shuttle Radar Topography Mission (provides DEMs of the Earth's surface)
VBA	Visual Basic for Applications (Microsoft's programming language designed for the Office package)

Content of Supplement DVDs

Supplement DVD 1

Diss_Sossna_ClimateSettlementPeru.pdf: *A digital version of this thesis in PDF format.*

1_Catalogs

- Site_Catalog.pdf: *A catalog of all archaeological sites with settlement remains documented by the Palpa Project.*
- Settlement_Catalog.pdf: *A catalog of all settlements defined for the present study.*
- List_of_Site_Numbers.pdf: *A reference list for provisional site numbers assigned by the Palpa Project (PAP-), site numbers assigned after the official Peruvian registration system (PV-), and popular names of sites.*

2_StatisticsSheets

- 10 PDF files subsuming basic statistical information on settlements for each phase
- Cabezadas: 10 PDF files subsuming basic statistical information on cabezadas settlements for each phase
- Foothills: 10 PDF files subsuming basic statistical information on foothill settlements for each phase

3_SettlementsDB

- SettlementsDB.mdb: *MS-Access® database containing all data on settlements used in the analyses. Please consider the technical information in the file Readme.txt.*
- Images and Images_PAP: *These folders contain low resolution overview images of archaeological sites that are displayed in the main user form and some sub-forms of the settlements database.*

4_A1_Maps_SettlementsPerPhase

- 10 fully labeled DIN-A1-size high-resolution maps in PDF-format showing all settlements per phase. *In addition to symbol markers indicating size and status class, the shapes of the site sectors assigned to each settlement are shown. The thickness and direction of hatches indicate how much of each sector belongs to the respective settlement and whether the chronological and functional classification is reliable. Each file contains two sheets: one for the foothills section and another for the cabezadas.*

5_Charts

- SettlementsCharts.xlsm: *MS-Excel® workbook containing charts and graphics related to statistical calculations. The data tables were originally linked dynamically to the Palpa Project database. Since this database is not included in this DVD, they were converted to static tables in this version. The first worksheet has a button for the automatized export of all charts in PDF and PNG format.*
- PDF: *Contains the charts exported as PDF file.*

- PNG: *Contains the charts exported as PNG file.*

6_Climate Data

- AgriculturalPotentialSouthCoast.xlsx: *MS-Excel[®] workbook containing data published by ONERN on river discharge and cultivable land in the drainages of the South Coast. The data was used for further calculations and for designing the charts also included in this workbook.*
- FAO_MeteoData_Americas.mdb: *MS-Access[®] database containing meteorological data of the Americas compiled by the United Nations Food and Agriculture Organization (FAO). Some tables were restructured according to the requirements of this study and a new user form was designed. Two reports were set up which provide an overview of the available data collected at meteorological stations in Peru. The first report is order by station names while in the other the data of stations located in the same environmental zone (as proposed by Javier Pulgar Vidal 1981) is grouped.*
- ClimateData_Peru.pdf: *The first report exported as PDF file.*
- ClimateData_EnvironZones.pdf: *The second report exported as PDF file.*
- ClimateStations.png: *Overview map of the Central Andes showing the location of meteorological stations.*

7_EcozoneShifts

- EcozoneShifts.xlsx: *MS-Excel[®] workbook containing a table of interpolated precipitation values at altitudes in 50-m-intervals under different climatic conditions according to Chapter 4.3.1.*

Supplement DVD 2

GeoData

- KMZ: *Contains basic vector data sets representing archaeological sites and settlements in the KMZ file format for use in Google Earth[®]. Details are given in the file Readme.txt.*
- UTM_18S: *Contains diverse geodata in raster (TIF) and vector (SHP) file formats projected to the Universal Transverse Mercator System, Zone 18 S (WGS 84). Details are given in the file Readme.txt.*
- GCS_WGS84: *Contains diverse geodata in raster (TIF) and vector (SHP) file formats in a geographic coordinate system (WGS 84). Details are given in the file Readme.txt.*

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