WAR, CHRONOLOGY, AND CAUSALITY IN THE TITICACA BASIN

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In the Late Intermediate Period (ca. A.D. 1000–1450), people in many parts of the Andean highlands moved away from rich agricultural lands to settle in defensive sites high on hills and ridges, frequently building hilltop forts known as pukaras *in Quechua and Aymara. This settlement shift indicates a concern with warfare not equaled at any other time in the archaeological sequence. While the traditional assumption is that warfare in the Late Intermediate Period resulted directly from the collapse of the Middle Horizon polities of Wari and Tiwanaku around A.D. 1000, radiocarbon dates presented here from occupation and wall-building events at pukaras in the northern Titicaca Basin indicate these hillforts did not become common until late in the Late Intermediate Period, after approximately A.D. 1300. Alternative explanations for this late escalation of warfare are evaluated, especially climate change. On a local scale, the shifting nature of pukara occupation indicates cycles of defense, abandonment, reoccupation, and wall building within a broader context of elevated hostilities that lasted for the rest of the Late Intermediate Period and beyond.*

En el Período Intermedio Tardío (ca. 1000–1450 d.C.), los habitantes de muchas partes de la sierra andina abandonaron terrenos productivos para asentarse en sitios defensivos en colinas, a veces construyendo asentamientos amurallados en las cumbres, llamados "pukaras" tanto en Quechua como Aymara. Este cambio demuestra una preocupación por la guerra no conocida anteriormente en la secuencia arqueológica. Según la interpretación tradicional, el conflicto resultó directamente del colapso de Wari y de Tiwanaku, aldredor de 1000 d.C., pero los fechados radiocarbónicos de un grupo de pukaras de la cuenca septentrional del Titicaca, presentados en este trabajo, indican que la mayoría de estos pukaras no fueron construidos ni ocupados hasta el final del Intermedio Tardío, después de aproximadamente 1300 d.C. Se evalúa las explicaciones alternativas para esta intensificación tardía de la guerra, sobre todo las condiciones ambientales adversas. En una escala más pequeña, los ocupaciones variables de pukaras indican ciclos locales de la defensa, del abandono, de la reoccupación, y de la construcción de murallas dentro de un contexto más amplio de conflicto agravado que duró el resto del Intermedio Tardío y aún después.

The Late Intermediate Period, ca. A.D. 1000–1450, has long been seen by archaeologists as an era of conflict and political fragmentation (Julien 1993; Matos 1999; Parsons and Hastings 1988). Many parts of the Andean highlands witnessed a settlement shift to more defensively located sites. Hilltop forts and refuges abounded, protected with massive stone-built walls and sometimes ditches (e.g., D'Altroy and Hastorf 2001; Hyslop 1976; Parsons et al. 2000). The outlines of this pattern have been recognized for some time, particularly for the central and southern Andean highlands, and recent research has confirmed it in other areas (see below). However, a better understanding of the causes and ramifications of this widespread conflict has been hampered by the lack of refined Late Intermediate Period chronologies. As Parsons and Hastings lamented nearly two decades ago,

> All too often we have been forced to talk in static terms about a period nearly 500 years long which must ultimately provide critical information regarding the dynamics of decay in major inter-regional cultural systems of the Middle Horizon and the dynamics of development for Late Horizon pan-Andean organization [Parsons and Hastings 1988:228].

Even now, most studies, unable to construct fine-grained ceramic sequences or run numerous radiocarbon dates, have little choice but to treat the Late Intermediate Period as a monolithic and homogenous era. The result is an artificial archaeological vision of a four-century-long epoch of continuous warfare, in which we cannot see periods of peace, short-term political consolidation, or

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the shifting construction and abandonment of settlements. Yet where more detailed chronological data are available, they indicate significant change within the Late Intermediate Period, including population growth, settlement shifts, political consolidation, and intensified warfare (Covey 2008; Earle et al. 1980, 1987; Julien 1988; Nielsen 2002; Owen 1995; Stanish 1985, 1992, 2003). This paper presents new evidence on the chronology of Late Intermediate Period warfare from one of the areas in which it was first recognized: the Titicaca Basin of southern Peru. Here, a suite of radiocarbon dates brings into better focus the processes of wall construction, defensive occupation, abandonment, and reuse of fortified sites. These data shed light on the causes of warfare on both macroregional and local scales.

Explaining Warfare: Scales of Analysis and Violent Cycles

When discussing group violence across a spectrum of regions and centuries, it is useful to define "warfare" broadly: as a state of hostility between groups of people who consider themselves separate political communities, whose members engage in armed, potentially lethal, culturally sanctioned violence and acts of destruction against one another. This definition borrows from Ferguson (1984), Meggitt (1977), Milner (1999), and Webster (1998), and follows current usage in anthropology. Warfare thus defined excludes acts of interpersonal violence between individuals, as well as collective violence directed specifically at one individual, such as an execution (Kelly 2000). It also excludes strictly contained "ritual battles" such as Andean *tinku*, which do not arise from hostile intergroup relationships. However, it encompasses a great range of group violence with significant differences in conduct and consequences, from occasional, expedient killings and ambushes between enemy villages, to the organized, well-supplied, long-range campaigns of centralized polities involving thousands of soldiers.

The causes of war, too, may differ significantly, depending partly on the degree to which warring societies are politically centralized (Ferguson 1984, 1990; Keeley 1996; Reyna 1994). Where small numbers of powerful leaders can order large numbers of soldiers into battle, wars are pursued for reasons that these leaders deem sufficient: to accrue wealth and greater power, buttress legitimacy, deflate a rival faction, or perhaps even fulfill an ideological imperative. It is more difficult to explain warfare where decision-making power is diffused throughout society and individual fighters have a good deal of say in whether and how to fight. Such contexts span the gamut from decentralized, egalitarian societies to weakly centralized chiefdoms, and extend to contemporary factional conflicts in which individual fighters may be galvanized by influential figures or petty warlords with limited coercive power. Given the obvious disincentives, why do people with some latitude for choice choose to engage in collective violence, and why have they done so with such appalling frequency?

Anthropologists have sought causes on a number of levels (see Allen and Arkush 2006, Ferguson 1984, 1990, 2001; Snyder 2002), and the theoretical complexity of this literature reflects both the diversity of perspectives that flourish in anthropology and the truly tangled web of conditions, motivations, and rewards—not to mention pretexts—for violence in human societies. Some scholars view warfare as the expression of universal drives rooted in the evolution of our species: territorial expansion and defense (Thayer 2004; Wrangham and Peterson 1996), male competition for mating opportunities (Chagnon 1988; Daly and Wilson 1988), xenophobia based in kin selection (Shaw and Wong 1989), or a combination of such urges (Gat 2000a, 2000b; van der Dennan 1995). Materialist explanations, by contrast, view warfare as a contingent response to population pressure, resource stress, or environmental crisis (e.g., Ferguson 1990, 2001; Harris 1974; Vayda 1976). While applicable to modern-day conflicts (Gleditsch 1997; Homer-Dixon 1999) and historically recorded wars (Zhang et al. 2007), the materialist view of warfare has particularly found favor among archaeologists, who draw robust connections between periods of warfare and episodes of nutritional stress, rising populations, or environmental crisis (Bamforth 2006; Billman et al. 2000; Haas 1999; Haas and Creamer 1993; Jones et al. 1999; Lambert 1997, 2002; LeBlanc 1999, 2003; Lekson 2002; Milner 2007; Nunn et al. 2007; Petersen 1988; Raab and Larson 1997). This view also draws some support from ethnology: for instance, Ember and Ember (1992) find that across cultures, frequent warfare is correlated with the fear of unpredictable natural disasters affecting resources. Alternatively, materialists may assign blame to the material and political rewards of warmongering for warriors, leaders, and aggrandizers (Ferguson 1990).

Meanwhile, political explanations argue that war arises when stable peacemaking is not possible because authority structures are too weak or nonexistent, a distinctly Hobbesian viewpoint that echoes the stance of Sahlins (1968) and Service (1968) that warfare is a normal state for peoples without supra-local governmental institutions. This explanation has been applied to cases from the Yanomamö (Chagnon 1968) to conflict-ridden "failed states" such as Somalia and Yugoslavia (Brubaker and Laitin 1998; Desjarlais and Kleinman 1994; Jackson 1990; Simons 1995). Anthropologists have also examined correlations between warfare and aspects of social structure (e.g., Otterbein 1970, 2004). Sahlins (1961) links territorial conflict to segmentary lineage organization, which allows politically autonomous segments to band together against enemies in ever-larger forces along lines of genealogical relatedness. Kelly (2000) extends this hypothesis, concluding that in segmentary societies, an attack on one group member is perceived, not as an individual offense, but as an attack on the whole group by a whole offending group, requiring retaliation against any member of that group, and potentially leading to endless vendettas. Meanwhile, cultural approaches (e.g., Bonta 1999; Robarchek and Robarchek 1998; Wiessner and Tumu 1998) stress the understanding of violent action within its cultural matrix, as a contextually specific social event freighted with meaning. For these scholars, individual and group decisions about war are strongly affected by the socialization of children to react to injury, the interpretation of death and disease as hostile sorcery, ideals of masculinity, autonomy and honor, starkly defined ethnic identities, and other elements of cultural practice and worldview.

It should be clear from this brief overview that these causal factors operate on different spatial and temporal scales (some of which are more amenable to archaeological investigation than others), and that by and large they articulate with each other, rather than being mutually exclusive. The motivations of warriors in a particular war exist on a shorter and more local scale than either the cultural framework that informs their decisions or long-term trends in material scarcity that encourage patterns of heightened warfare; more eternal still is the evolved human psychology that makes war possible. Yet anthropological debates over the causes of war (for instance, Gat 2000a, 2000b; Ferguson 2001) have often been clouded by incompatible scales of analysis. Here I assume that causes and processes operating in the *longue duree* are distinct from shorter-term processes, though they articulate with them, and likewise, that larger regional scales, especially those that encompass politically independent communities, are more likely to reflect underlying rather than proximate causes of war.

Some attempts have been made at more holistic and comprehensive theories of war's causes. For instance, Ferguson (1990) proposes a model in which a nested hierarchy of determinants—infrastructural (population, resource availability, subsistence technology), structural (kinship and sociopolitical organization), and superstructural (belief, "culture")—progressively constrain and influence the practice of war. While a great step in the right direction, this model fails to capture the way repeated wars themselves alter material conditions, cultural understandings, and social structure (Allen and Arkush 2006). For instance, frequent warfare itself exacerbates resource scarcity through the displacement of refugees to marginal areas, population nucleation for defense, and the creation of unutilized buffer zones (LeBlanc 2006). Warfare may affect social patterns and cultural values, causing people to valorize martial prowess (Allen 2006), socialize their children to fear outsiders (Ember and Ember 1992; Kusimba 2006), and laud elites for military exploits. Snyder (2002) proposes instead that war and its causes be seen as a complex evolving system in which warfare, material constraints, social patterns, and cultural norms affect each other.

This paper explores the potential of a multilayered explanatory approach to warfare for the Late Intermediate Period through the examination of a kind of material culture particularly amenable to archaeological analysis: the fortified site. Partly, fortification is used here (as it normally is by archaeologists) simply as an index of war, so that the spread and increased defensibility of fortified sites is interpreted as evidence for an elevated threat of war. But, in line with the above discussion, I also propose that fortifications and defensive settlement patterns had the potential to alter regional sociopolitical landscapes, themselves influencing choices about violent action for generations. Defensive settlement patterns, fortifications, and buffer zones mark social categories on the land, making allies and enemies more easily inheritable. They allow their users to plan offensives more securely, encouraging aggressive solutions to disputes. Individually, fortified sites are difficult to vanquish; in multiples, forts impede the conquest and stable control of hostile territory by forcing conquerors to capture and garrison each fort. They thus tend to entrench existing political patterns. When closely controlled by a central authority, forts cement that authority, but in contexts of fragmentation, heavily fortified terrain is especially prone to repeated cycles of inconclusive violence because it is so difficult to conquer and consolidate. In these ways, novel defensive uses of landscape, settlement, and walls alter political relationships for the long term.

The Problem of Warfare in the Late Intermediate Period

The warfare of the Late Intermediate Period begs for an adequate explanation because of its sheer scale. The pattern of defensive hilltop settlements and fortified sites was recognized for the central and southern highlands decades ago, but recent research has demonstrated that it extends from at least northern highland Peru, throughout central and southern Peru and highland Bolivia, to northern Chile and northwestern Argentina. The northern Peruvian sierra around Cajamarca and Huamachuco is dotted with hilltop settlements, sometimes lightly fortified (Julien 1988, 1993; Topic and Topic 1987), and defensive siting, fortification, and weapons such as sling stones and maceheads are common in Late Intermediate Period sites of the Chachapoyas region (Narváez 1987; Schjellerup 1992, 1997). Patterns of hilltop settlement and some fortification characterize the Callejón de Huaylas and both sides of the upper Marañon River (Bonnier 1978; Mantha 2006; Wassilowsky 1999). The central Peruvian highlands around Junín, Jauja, and Ayacucho have benefited from archaeological surveys that clearly demonstrate systems of hilltop walled settlement. Small, dispersed defensive sites, as in highland Junín (Parsons et al. 1997, 2000) and Asto (Lavalee and Julien 1973), suggest small-scale raiding for stores and livestock, while the densely occupied hillforts of the upper Mantaro (D'Altroy and Hastorf 2001; Earle et al. 1980, 1987; Hastorf et al. 1989) indicate warfare on a much larger scale. South of Ayacucho and into Andahuaylas, patterns of defensive and fortified sites continue, varying in scale (Meddens 1999; Valdez et al 1990, 1994; Vivanco 1999). There is some evidence of warfare around the margins of the Cuzco area (e.g. Kendall 1996), although the birthplace of the Incas features mostly nondefensive settlement in the Late Intermediate Period (Bauer 1992, 2004; Bauer and Covey 2002; Hefferman 1996), suggesting that political consolidation proceeded either peacefully or too rapidly to result in fortification. Hilltop forts dominated the Titicaca Basin in the Late Intermediate Period (Arkush 2005; Frye and de la Vega 2005; Hyslop 1976; Neira 1967; Stanish 2003; Stanish et al 1997). Further south, smaller and less politically centralized populations built and used the plentiful hillforts of the Bolivian *altiplano* (Lecoq 1997; Lecoq and Céspedes 1997; Nielsen 2002), northern and eastern Chile (e.g. Llagostera and Costa 1999; Núñez and Dillehay 1978; Schiappacasse et al. 1989) and northwest Argentina (DeMarrais 1997; Nielsen 2001).

The upper portions of Pacific coastal valleys also betray evidence of warfare. In northern Peru, defensive wall systems and strategically placed fortified sites of the upper Jequetepeque, Chicama, and Moche watersheds may have controlled highland-coast traffic and protected Chimor from highland incursions (Julien 1988; Krzanowski 1977, 1983; Topic and Topic 1987). In the central and southern coastal valleys—Chillón (Farfán 1995; Silva 1992), Colca (Wernke 2003), Moquegua (Moseley 1989; Owen 1995; Stanish 1992), and valleys to the south (e.g., Reindel 2005; Santoro et al. 2004)—fortified hilltop settlements suggest endemic warfare without such centralized political administration.

There is also a small but growing body of bioarchaeological evidence for violent conflict in the Late Intermediate Period (de la Vega et al 2005; Jakobsen et al 1986–1987; Nystrom and Verano 2003; Torres-Rouff and Costa 2006; Verano 2002). Several of these studies find that cranial trauma was common on both males and females. This may indicate that warfare was not confined to pitched battles, but included ambushes, raids, and massacres directed at noncombatants—a pattern typical of relatively small-scale, decentralized societies (Keeley 1996; Milner 1999).

The geographic extent and intensity of this conflict was unprecedented. Warfare was not unique to the Late Intermediate Period, of course, but at no other time did it so strongly threaten populations, driving them into remote mountain fastnesses across half a continent. Yet while warfare was pan-Andean, individual wars must have been mostly local or subregional affairs, for outside of the Chimu empire and the Cuzco Valley, polities were small in scale. There are only a handful of known sites with over 500 houses, mostly regional centers in the central and south-central highlands. Even in the areas around these centers, settlement hierarchies, when they are present at all, are small geographically, and satellite sites are often fortified or defensible, demonstrating that the larger centers could not fully protect their vicinities. Centralized storage facilities are almost nonexistent in the highlands, and there is only limited evidence for site planning, indicating a pervasive decentralization of political and economic activity. Yet the wide extent of evidence for conflict undermines the idea that it ultimately resulted from local processes and conditions. A plausible explanatory framework must apply across the scale of the Andes, while at the same time recognizing the local nature of political agency in this time of fragmentation and regionalization.

Explaining Warfare in the Late Intermediate Period

Because the Late Intermediate Period is by definition a hiatus after the Middle Horizon collapse, warfare has traditionally been seen as a direct outgrowth of that collapse. This position was initially outlined by Hyslop (1976:134), and many other discussions have followed his lead. A typical example can be drawn from Kolata (1993:299):

> The demise of the Tiwanaku empire brought with it widespread political instability. The "Pax Tiwanaku" imposed by the empire could no longer repress ingrained, inter-ethnic hostilities, and the former provinces of the empire dissolved into small polities bitterly contesting land, water, and other natural resources. The political disturbances and economic chaos that followed in the wake of Tiwanaku's collapse are brutally reflected in the characteristic pattern of settlement of this period: the fortified village.

This viewpoint falls within the tradition of political explanations of war: that war is expectable when not suppressed by governments. It aligns with the way social scientists trace modern-day factional conflicts to the decay of the strong Weberian state (Brubaker and Laitin 1998; Desjarlais and Kleinman 1994; Jackson 1990), and even with the way the popular press traces them to ancient "tribal" or ethnic hatreds that are somehow unloosed when states weaken. This is not to critique the standard explanation of Late Intermediate Period violence on theoretical grounds, for it is genuinely plausible: state collapse has often been followed by warfare. The Middle Horizon polities ushered in new ways of organizing societies over far-flung realms, and their disintegration may have caused great social disruption even in regions never under their direct purview (for Late Intermediate Period fortification and defensive settlement patterns occurred well beyond the areas of former Wari and Tiwanaku control). Instead, the hypothesis is best tested through fine-grained chronologies: did warfare follow on the heels of state collapse or not?

Alternatively, some archaeologists have turned to environmental change to explain intensified conflict within their regions (Nielsen 2001, 2002; Seltzer and Hastorf 1990; Torres-Rouff and Costa 2006). As more paleoclimatological studies emerge, it becomes possible to draw connections between climate change and major cultural transitions. Yet information on prehistoric climate is still partial and difficult to interpret, and archaeologists must examine correlations in timing carefully.

The chroniclers, too, touched on the question of why wars were fought in the pre-Inca era. In general statements clouded by Spanish and Inca cultural biases, they attribute pre-Inca warfare to political anarchy and to a vaguely imputed culture of bellicosity. As proximate causes of war, they stress the material goals of groups and individuals. For instance, descriptions of warlords (such as the Colla paramount lord) indicate that one ostensible goal was the conquest and political control of larger territories and subject populations. However, some aggressors sought to wrest land from their foes,

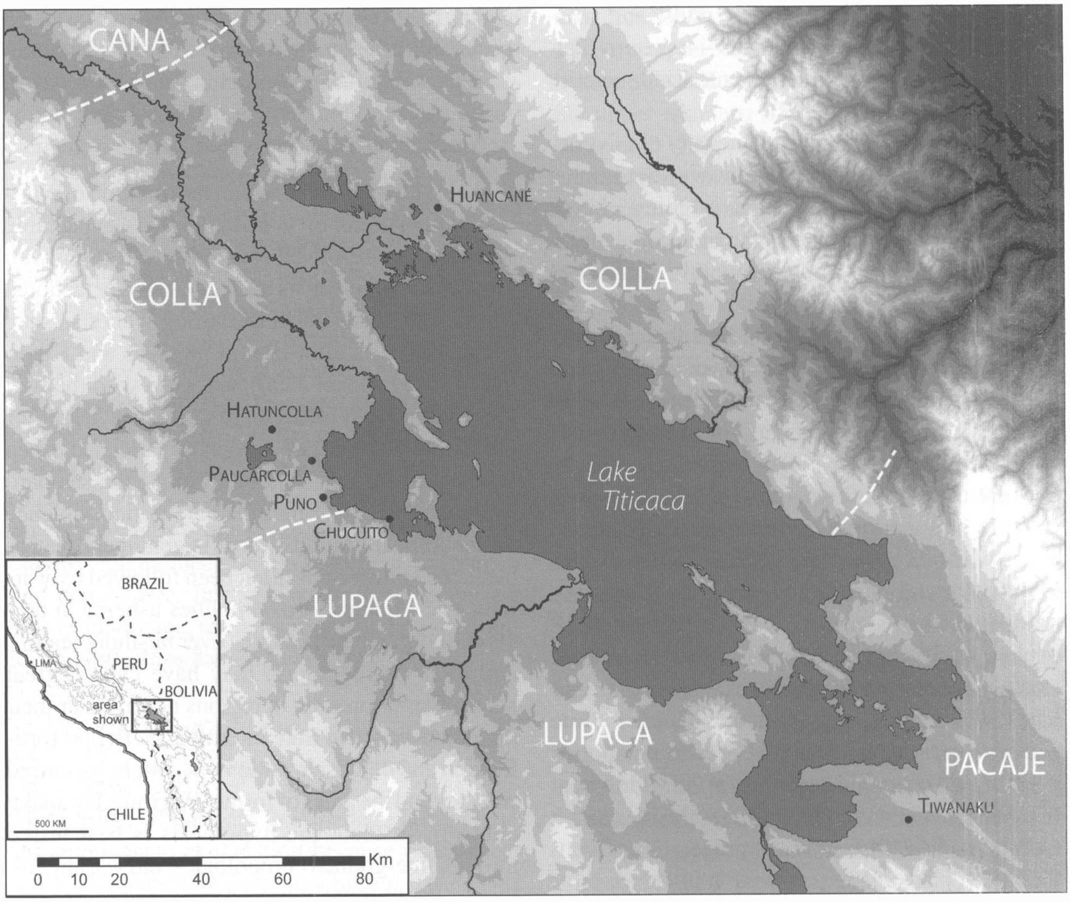

Figure 1. The Lake Titicaca Basin, with the distribution of ethnic groups in the early Colonial period.

rather than conquer and incorporate them as subjects, suggesting that shortages, population pressure, and stresses on marginal groups were implicated: Cieza de León asserts that wars were fought "over the farmlands or for other things" (Cieza 1985:6 [1553]), and Cobo concurs that wars were fought over "water and land, which they would take from each other" (Cobo 1979:97 [1653]). Cieza also states that pre-Inca Andeans took "the spoils that they found and the women of the vanquished" back to their pukaras (Cieza 1985:6 [1553]).

LeBlanc's analysis (1981:340–353) of Toledo's *visita* in the Wanka area elegantly highlights the interplay of factors in local decisions to go to war. Informants stated their pre-Inca ancestors fought wars primarily over arable land, as well as stored food, women, and livestock, but they also said that *sinchis*—local war leaders chosen for their prowess in war, or who sometimes coerced their communities into following them—encouraged and perpetuated wars in order to solidify their own power, and disproportionately won lands and wives in war. Here, causal factors operated on a number of scales. A setting of political fragmentation allowed potential competition between communities. Tensions over land and other resources may have stemmed from resource shortage. Competition for women (viewed by some scholars as an evolved male behavioral pattern) may have been a significant factor in the support of individual warriors for particular wars. Finally, wars were encouraged by the machinations of ambitious *sinchis*.

The Colla Region in the Titicaca Basin

The Titicaca Basin is a particularly appropriate arena for investigating the causes of Late Intermediate Period warfare (Figure 1). It was one of the regions where the pattern of Late Intermediate

Period warfare was first noted (Hyslop 1976), and notable it is indeed: the steep hills that jut from the flat plains of the basin are dotted with the imposing hillforts known as *pukaras* in Quechua and Aymara. Since the Titicaca Basin housed the state of Tiwanaku, if Late Intermediate Period warfare erupted as a result of state collapse, this area should have been quickly affected.

In the Middle Horizon, the southern Titicaca Basin was dominated by Tiwanaku, while the northern basin was not fully incorporated (Stanish et al. 2005). Tiwanaku centers were established near modern Puno (Schultze 2000) and Paucarcolla (Johnson 2003). North of Paucarcolla, Tiwanaku pottery is present in small quantities (e.g., at the mouth of the Huancané valley [Stanish et al. 2005]), and a largely unrelated ceramic tradition, provisionally termed Huaña, may have been used by contemporary, non-Tiwanaku affiliated peoples (Stanish 2003). Because Huaña has only begun to be identified (that is, differentiated from earlier Pucara or later Collao pottery), Middle Horizon settlement and society in the northern basin are not well understood.

Tiwanaku's collapse can be dated to approximately A.D. 1000, when its colonies in Moquegua were abandoned and monumental construction at the city of Tiwanaku ceased, although some occupation and craft production may have lingered on in the city until ca. A.D. 1150 (Janusek 2004; Owen 2005). In the Late Intermediate Period, populations in the better-studied southern and southwestern basin moved to dispersed settlements, abandoning raised fields and lake margins for areas more suited to pastoralism and rainfall agriculture (Frye and de la Vega 2005; Janusek 2004; Stanish et al 1997). Hilltop settlement became common in nearly all portions of the Titicaca Basin, including the pukaras that constitute the focus of this study. The Late Intermediate Period also saw changes in burial patterns and ceramic styles, and the cessation of long-lived forms of ceremonial architecture (platform mounds, sunken courts, and monoliths). Contact-period ethnohistories describe regional polities engaged in frequent warfare: the Collas in the northern basin; the Lupacas, neighbors and bitter rivals on the southwestern side of the lake; the Pacajes south of the lake, in Tiwanaku's former heartland; and the Canas, the Collas' enemies to the north (Betanzos 1996:93 [1551–1557]; Cieza 1984:274, 279 [1553], 1985:15, 22, 110, 121 [1553]; Cobo 1979:139–140 [1653]; Sarmiento 1988:105–106 [1572]). These groups, particularly the Collas and the Lupacas, are described as politically unified realms (*señoríos*) led by powerful and possibly hereditary warlords, yet the archaeological landscape of numerous pukaras, relatively small site hierarchies, and rather subtle status distinctions within communities, suggests less unified and less hierarchical societies (Arkush 2005; Frye 1997; Frye and de la Vega 2005). However, the chroniclers' accounts of frequent warfare are clearly supported by defensive and fortified settlement patterns found throughout most of the Titicaca Basin (Arkush 2005; Barreda 1958; Bennett 1933, 1950; Frye 1997; Hyslop 1976; Neira 1967; Stanish et al. 1997; Stanish 2003; Tapia 1978a, 1978b, 1985; Tschopik 1946). This pattern can be seen as a regional manifestation of the very widespread conflict of the Late Intermediate Period.

While several archaeological studies have investigated the neighboring Lupacas to the south (de la Vega 1990; Frye 1997; Frye and de la Vega 2005; Hyslop 1976; Stanish et al. 1997), the Collas of the Late Intermediate Period have been surprisingly understudied for a group with such stature in the ethnohistoric literature. Several nonsystematic reconnaissances and site visits (Fuentes 1991; Neira 1967; Palacios 1934; Rowe 1942; Tschopik 1946; Vásquez 1940a, 1940b) clearly established the characteristic Late Intermediate Period settlement pattern of fortified pukaras, defensible unfortified sites, and tombs ranging from tower-like *chullpas* (aboveground burial structures) to cist graves. Excavations at Hatuncolla (Julien 1983) revealed that the purported pre-Inca capital of the Collas was in fact an intrusive Inca settlement, opening to question the political centralization of the Late Intermediate Period Collas, although the long-term use of Sillustani as a major burial center (Ayca 1995; Revilla and Uriarte 1985; Ruiz 1973) may indicate a certain cultural or ethnic unity for the Collas, or a subgroup of Collas.

Pukaras

The data used in this analysis come from a project that investigated pukaras of the northern and northwestern basin in the territory attributed to the Collas (Figure 2). Among other aims, the project was

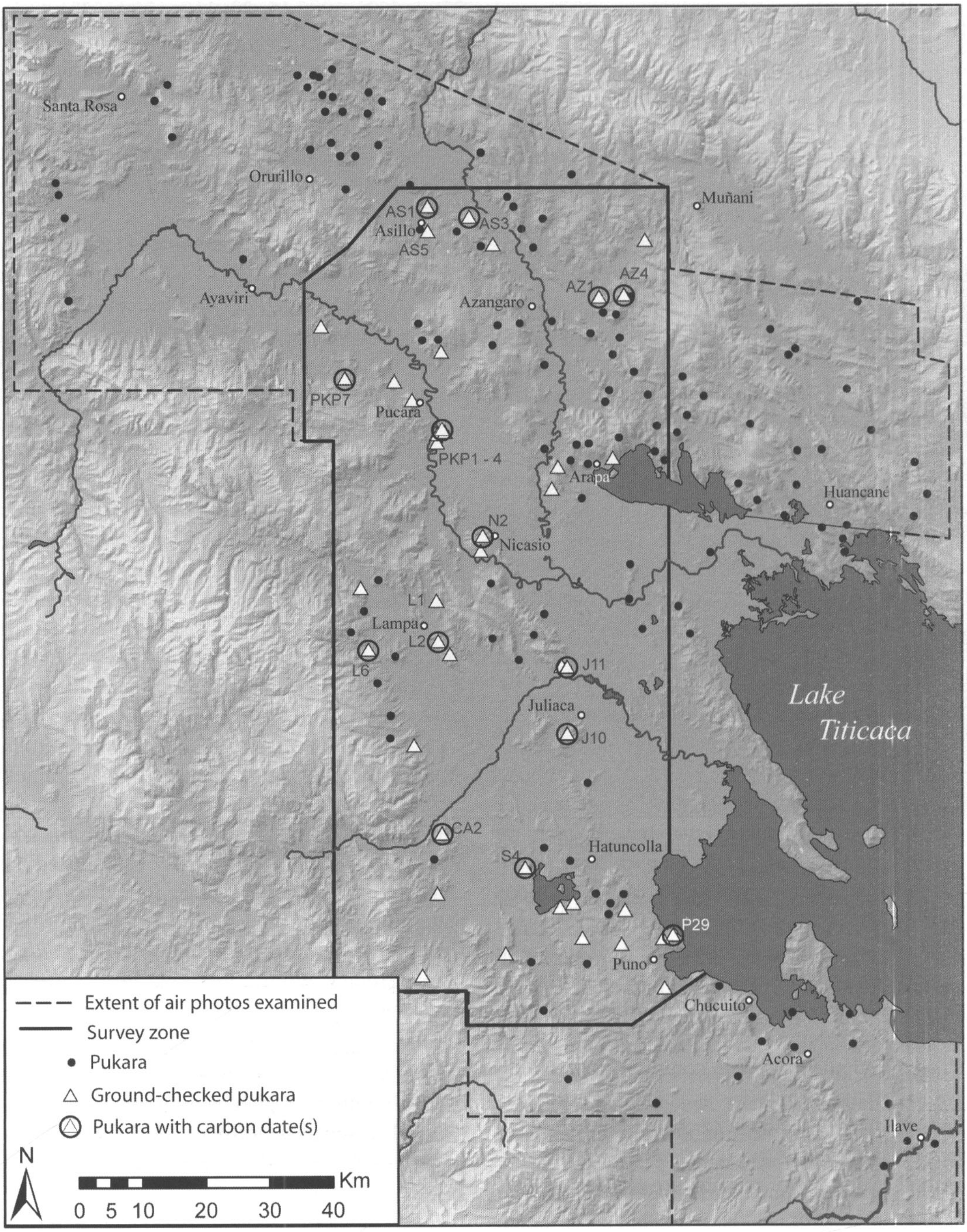

Figure 2. Pukaras in the northwest Titicaca Basin.

designed to determine the chronology of fortification in the region and potential correlations in timing with events such as the collapse of Tiwanaku. Pukaras were identified based on air photos, supplemented by ground sighting, toponyms, and the published literature. A sample of 44 pukaras was ground-checked and mapped, and carbon samples were obtained from 1-x-1-m test pits and defensive wall mortar at a subset of 15 pukaras. Using air photos for the identification of pukaras permitted an investigation that was both systematic and geographically extensive. Thus, while Colla pukaras broadly resemble pukaras of the Lupaca area (Frye 1997; Hyslop 1976), the large number assessed here allows for a more comprehensive picture of variability in pukara use, size, and chronology. However, this methodology did leave some important questions unanswered, such as the nature of nonfortified Late Intermediate Period settlement. Several recent and ongoing projects of full-coverage pedestrian survey in the Colla zone (e.g., Plourde and de la Vega 2001; Stanish et al. 2008) promise to elucidate the complete settlement patterns of the Late Intermediate Period. In the better-studied Lupaca area to the south, small, unfortified villages and single-household hamlets cluster near pukaras, with possible buffer zones between them (Frye 1997).

Colla pukaras of the northern Titicaca Basin conform to a basic canon in terms of location, wall construction, the design and placement of house structures, and typical artifacts. They are found on hills of varying size and steepness between about 3,900 and 4,600 masl, with most about 4,100 masl, and they are preferentially located near the plains and river valleys, giving them access to both hill-base agricultural zones and higher pasturage. They have excellent views of their surrounding area, including, usually, a number of other pukaras. Because most pukaras are above the range of cultivation, their architecture can be quite well preserved.

The most impressive form of standing architecture is the multiple defensive walls that supplement the naturally strategic setting of these sites, encircling the hilltop and habitation areas. These walls were clearly designed to form defensive barriers in a cost-efficient manner. They take advantage of cliffs or rock outcrops, linking these natural defenses into a chain. They are largest on the sides of the hill that are most approachable, and they may peter out on steep terrain. Defensive walls are sturdy constructions, almost always built with a double face and rubble fill, totaling 1 to 2 m thick and, where their original height is discernable, at least 1.5 m high. At the largest pukaras they are truly massive, up to 4 m thick and 5 m high. Some walls, especially on the more vulnerable sides, incorporate parapets—a giveaway for defensive intent, according to Topic and Topic (1987)—and occasionally they include watch posts or platforms. The presence of parapets points to the importance of slingstone fire in the defense of these sites, and indeed, piles of unworked river cobbles are present near the walls at several pukaras. Where there is more than one defensive wall (in 37 out of 44 pukaras), the walls are nearly always placed 15 to 30 m apart, well under the effective range of slings (at least 50 to 60 m; see Keeley [2007:73]; Rawls [1975:130]). This positioning suggests that the spaces between walls were partly intended as "killing alleys," trapping attackers in a restricted zone where defenders along the inner wall could direct a barrage of projectiles at them.

Table 1. Titicaca Basin Chronology.

Period	Phase	Date Range
Late Horizon		A.D. 1450–1532
Late Intermediate Period	Phase II	A.D. 1300–1450
	Phase I	A.D. 1000–1300
Middle Horizon		A.D. 400–1000
Formative	Late	200 B.C.–A.D. 400
	Middle	1300–200 B.C.

The design of entrances, necessary weak points in walls, also reveals defensive pressures. Pukara entrances consist either of several small, linteled doorways, or a smaller number of larger gates, or a combination. Gates are often baffled, screened with a separate parallel wall inside, or flanked by inset walls or platforms to each side, allowing the entrance to be monitored by defenders standing above (see Keeley et al. [2007] for a general treatment). Doorways are small (60 cm wide on average), forcing single-file entry, and could have been easily blocked from the inside with rubble or brush, especially where they slope uphill through the walls. In other words, these constructions are clearly intended for defense. The ongoing concern with warfare is shown by modifications to defenses over the course of pukara lifetimes: walls constructed in separate episodes, or thickened with additional faces, and blocked doors and access routes.

However, Colla pukaras were not invulnerable. At 37 of the 44 pukaras surveyed, we could not locate a present-day, year-round spring, pond, or cistern within the defensive walls. While a limited supply of water could have been stored in large jars, it seems clear that most pukaras did not have the water supply necessary to withstand a prolonged siege. Colla populations must have relied instead on fortifications to impede and discourage assaults or raids, and to delay attackers while allies could arrive. Prolonged sieges were probably beyond the military and logistical capacity of surrounding societies.

While these sites were clearly defensive, they were also complete settlements where communities lived and engaged in a multitude of activities. Nearly 90 percent (39 of 44) are associated with habitation areas, usually located inside the walls. Circular house foundations, 3–4 m in diameter, are usually visible on the surface.[1] Surface artifacts from domestic occupation (ceramics, spindle-whorls, flakes, and grinding stones) are plentiful, and 10 test-pits placed in house structures found evidence of domestic use (including informal hearths or ash lenses, use surfaces, faunal bone fragments, and ceramic and lithic artifacts including spindle-whorls). However, floors are not highly compacted, and in only two cases was more than one potential floor identified in a single house. This preliminary evidence may suggest that houses were not used intensively over long time periods. The spread of carbon dates at some pukaras, the density of artifacts, the modifications to pukara defenses, and use-wear of grinding boulders, steps, etc., indicate that some pukaras were indeed occupied and used for a considerable length of time, but this does not appear to be true for individual houses. Houses may have been periodically razed, terraces shored up and re-leveled, and new houses constructed, instead of a single house being used repeatedly by multiple generations.

The internal layout of pukaras is variable and determined to a great degree by the topography of the hill. Most pukaras appear to be largely unplanned aggregations of house structures found in groups, several to a line or a residential terrace. At some larger pukaras, walled alleys meander through the terraces or compounds, imposing direction on the flow of foot traffic and dividing the site into sectors that may have helped to define separate social groups. Pukaras also include tombs as well as small storage structures, possible livestock enclosures, and sometimes, other special-purpose nonresidential architecture. Small storage structures, when present, are scattered throughout the residential areas, suggesting that each family or residential group managed its own surplus. By contrast, tombs are usually segregated in separate sections of the site, sometimes occupying the highest point of the hill, and may have formed an important spatial and social focus for the community and its ceremonies. The multifunctionality of these settlements demonstrates that pukaras housed complete communities, not just garrisons of soldiers.

Although Colla pukaras share aspects of general design and the types of features they encompass, there is also a great deal of variation. Pukaras range from unoccupied refuges and modest sites with less than half a hectare of surface material to large settlements with up to 18 hectares of artifact scatter, or 300 to 600 houses. Judging by the density of surface and excavation materials, some pukaras were occupied over a substantial amount of time while others were only briefly occupied, if at all. Pukaras also vary a great deal in the strength of their fortification walls and the accessibility of their natural landforms. Finally, the ratio between the total volume of defensive wall construction and the habitation area size (or number of structures) is quite variable, suggesting that while most pukaras could have been built by their resident populations, wall by wall, over a few dry seasons, others must have required a larger pool of labor.

Keeping this variability in mind, we can tentatively envision the multiple ways pukaras were used militarily. The largest were the major political centers in the region, protecting large populations, livestock, and stores behind massive walls, while the smallest shielded outlying families or small communities from small-scale raids. Some were temporary refuges, and some, permanent settlements. Many may have functioned as retreats for additional vulnerable populations living below, who would have contributed to the construction effort at some pukaras. With commanding views of the landscape, they made excellent sentry posts for detecting enemy advances ahead of time, signaling to other pukara communities,[2] and generally monitoring nearby activity. They were strategically placed to control surrounding lands, making it difficult to encroach upon that territory without defeating the pukara. They formed visible signals of a group's strength, and were surely deterrents for attack, yet it would probably be inaccurate to envision them engaged in a hostile but bloodless "cold war" that never included actual violence. Across cultures, decentralized societies that fortify their settlements engage in war frequently (Solometo 2006), and the ongoing concern with pukara defense, manifested in wall augmentation, blocked access routes, and stockpiled slingstones, speaks to a real and sustained fear of attack. The association of pukaras with war was strong enough to leave traces in Ludovico Bertonio's early colonial Aymara dictionary of 1612: their role as refuges is indicated by terms for fleeing and taking shelter in a pukara, and their occasional vulnerability, by phrases for capturing defeated pukaras and destroying them (in fact, Bertonio gives four separate ways of saying "to destroy a pukara").[3]

Finally, it is notable simply how common pukaras are in this region (Figure 2). The overall distribution of pukaras demonstrates that the threat of attack was pervasive. Patterns of buffer zones, fort clusters, and ceramic styles examined elsewhere (Arkush 2005, 2009) suggest that the Colla region was riven into several politically autonomous subregions each hosting several pukaras, a scenario consistent with relatively frequent local wars. The same appears true for the Lupacas (Frye 1997; Frye and de la Vega 2005; Stanish 2003). Yet the contrast between this archaeological picture of fragmentation or very loose coalition and the ethnohistories of powerful warlords controlling large territories is perplexing.

Following Stanish (2003:291–292), one possibility is to envision Titicaca Basin Late Intermediate Period populations as segmentary societies, used loosely here to refer to group identity or affiliation that is nested into larger and larger units along lines of perceived genealogical relatedness (Evans-Pritchard 1940). In segmentary societies, internal tensions and conflicts routinely cause larger groups to fission into equivalent units or segments, but these segments can band together again into formidable defensive confederations when threatened (Sahlins 1961). While traditional Andean kinship is flexible and based on bilateral descent, in contrast to the unilineal descent of "classic" segmentary societies, Andean corporate descent groups or *ayllus* nevertheless are nested in segmentary-like systems (Albarracín-Jordan 1996; Isko 1992; Platt 1986, 1987). These systems were probably in place by the end of the Late Intermediate Period if not before. Several traces of segmentary organization are detectable not only from the broader landscape of pukaras but from internal subdivisions within pukara sites. For instance, at the site of Apu Pucara (L6, Figure 5), there are five major and two minor clusters of storage structures, five different corrals, and six discrete clusters of tombs. Indeed, most pukaras have two or more tomb clusters. It seems likely that distinct social units inhabited pukaras simultaneously, keeping their identities separate in part through the maintenance of separate cemeteries. Farmland was also divided into segments at many pukaras, by vertical walls running down the hillside that probably date to the same era (the vertical walls abut defensive walls and are closely similar in construction). Altiplano communities today use vertical walls partly to divide farmland into slices for different social segments (Erickson 2000), so they may have held the same purpose in the past. In sum, there is evidence at this time for the persistence of smaller local identities, both within pukara sites (using distinct residential areas, cemeteries, storage structures, and field walls) and within larger clusters of sites (using different pukaras). This pattern of decentralization suggests the maintenance of a degree of local autonomy even within larger cooperative, and probably hierarchical, systems of pukaras.

Pukara Chronology

A pukara chronology can be drawn primarily from carbon dates and secondarily from ceramics to trace the course of fortification over time. Radiocarbon dates were obtained from a total of 15 pukaras: at 10, test pits yielded samples of burned wood from occupation or midden contexts, and at eight pukaras (including three where test pits were also excavated), samples of dry grass (*Stipa ichu*) were collected from interior mortar in defensive walls that was exposed where wall sections or doors had fallen. These grass samples give dates specifically for construction or rebuilding episodes of the defensive walls, and also avoid the potential curation problems of wood charcoal in the largely tree-less environment of the altiplano.[4] The resulting dates are shown in Table 2.

First, it should be noted that there was some limited use of pukara hilltops in the Middle to Late Formative period. One pukara in the northern survey area (AS1, Calvario de Asillo) features considerable Middle and Late Formative surface ceramics and a Middle Formative midden that gives a date between about 800 and 540 cal B.C. (1σ).

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Table 2. Radiocarbon Dates for Pukaras of the Colla Area. Calibrated with OxCal v3.8.

Phase	Lab No.	Site	Context	Material	Age BP	$\delta^{13}C$	Cal. A.D. (1σ)	Cal. A.D. (2σ)
pre-LIP	AA12871	AS1	midden, top	charcoal	2510 ± 125	−23.9	794–414 BC	902–376 BC
	AA12872	AS1	midden, base	charcoal	2520 ± 30	−23.2	788–545 BC	795–521 BC
	AA54218	AS3	defensive wall mortar (bad date?)[a]	dry grass	1370 ± 100	−25.9	564–775	437–890
LIP I	AA54233	AZ4	poss. house 2 floor	charcoal	955 ± 35	(−25)	1024–1122	1017–1163
	AA54220	AZ4	defensive wall mortar	dry grass	813 ± 81	−23.2	1072–1284	1028–1300
	AA54248	P29	terrace fill	charcoal	896 ± 40	−22.7	1042–1209	1030–1219
	AA54237	P29)	midden	charcoal	830 ± 35	−24.1	1188–1259	1071–1280
	AA54254	P29	terrace fill	charcoal	815 ± 44	−24.2	1191–1274	1068–1286
	AA54246	L2	midden	charcoal	766 ± 46	−23.9	1223–1284	1185–1300
LIP IIa	AA54247	L6	fill below house	charcoal	679 ± 34	−23.9	1282–1386	1277–1393
	AA12875	L6	house floor and below	charcoal	780 ± 65	−24.5	1190–1292	1042–1386
	AA12876	L6	midden	charcoal	725 ± 80	−23.9	1218–1388	1158–1408
	AA54226	N2	defensive wall mortar	dry grass	709 ± 34	−24.4	1274–1379	1243–1388
	AA54245	L2	terrace fill	charcoal	671± 34	−22.6	1284–1387	1279–1394
	AA12874	L2	midden	charcoal	580 ± 60	−23	1305–1411	1296–1434
	AA56163	S4	fill below hearth	charcoal	680 ± 30	−22.8	1282–1384	1277–1391
	AA56162	S4	hearth inside house	charcoal	670 ± 30	−24.9	1285–1387	1281–1392
	AA54249	S4	midden	charcoal	652 ± 43	−27.3	1294–1388	1282–1400
	AA54255	S4	terrace fill	charcoal	591 ± 44	−24	1306–1403	1298–1417
	AA54252	CA2	house floor	charcoal	651± 37	−24.4	1295–1388	1284–1398
	AA54234	CA2	house floor	charcoal	615 ± 35	−24.9	1303–1394	1297–1403
	AA54231	AS5	house floor	charcoal	656 ± 34	−24.8	1292–1388	1284–1395
	AA54242	AS5	poss. house floor	charcoal	596 ± 34	−23.7	1306–1400	1300–1410
	AA54243	AS5	fill below house	charcoal	650 ± 34	−23.7	1296–1388	1286–1397
	AA54241	AS1	fill below house	charcoal	631 ± 34	−24.6	1300–1390	1293–1400
	AA54229	PKP7	defensive wall mortar	dry grass	639 ± 47	−22.6	1298–1391	1285–1403
	AA54228	PKP7	defensive wall mortar	dry grass	565 ± 34	−24.3	1323–1417	1303–1428
	AA12873	AZ1	house 1 floor	charcoal	545 ± 85	−23.2	1305–1438	1280–1615
	AA54244	AZ1	fill below house 2	charcoal	623 ± 34	−23.6	1301–1394	1296–1402
	AA54232	AZ1	house 2 floor	charcoal	530 ± 47	−23.9	1330–1437	1304–1446
LIP IIb	AA54221	J10	defensive wall mortar	dry grass	516 ± 41	−22.2	1335–1438	1314–1451
	AA54223	J11	defensive wall mortar	dry grass	525 ± 34	−24.6	1401–1434	1324–1443
	AA54222	J11	defensive wall mortar	dry grass	487 ± 40	−17.3	1408–1444	1330–1478
	AA54217	AS1	defensive wall mortar	dry grass	427± 70	−25.2	1418–1622	1401–1640
	AA54219	AS3	defensive wall mortar	dry grass	502 ± 35	−24.2	1409–1438	1328–1451
	AA54225	N2	defensive wall mortar	dry grass	486 ± 38	−23.6	1411–1443	1332–1475
	AA54235	N2	exterior use surface	charcoal	510 ± 34	−24.2	1407–1436	1328–1446
	AA54236	N2	house floor	charcoal	491 ± 34	−22.7	1412–1440	1331–1455
	AA54253	N2	house floor	charcoal	435 ± 42	−23.8	1428–1484	1409–1626
	AA12877	N2	poss. floor	charcoal	405 ± 90	−23.5	1432–1630	1327–1665
	AA54227	PKP2	defensive wall mortar	dry grass	455 ± 34	−11	1422–1467	1408–1487
	AA54251	AZ4	hearth below house 1	charcoal	383 ± 59	−24	1444–1626	1436–1640

[a]Compare this date, for the middle wall, with sample AA54219 from the outer wall at the same site, which was in line with other pukara wall dates. The two walls are similar in condition and appearance.

Four additional sites in the southern basin also have considerable Late Formative ceramics. There is no evidence that defensive walls were constructed in the early period, but it may be significant that hilltops were sometimes occupied. However, as expected, most pukara use dates to the Late Intermediate Period.

The radiocarbon dates allow us to separate pukara use into two phases: the early Late Intermediate Period, before approximately A.D. 1275, when few pukaras were built or used, and a phase of greatly expanded pukara use in the late Late Intermediate Period and possibly beyond. (This second phase can also be split into two subphases at around cal A.D. 1400 based on carbon date distributions, but there are no dramatic changes between the subphases.) Pukaras used in these phases are shown in Table 3, along with their site

Table 3. Summarized Information on Pukaras with Radiocarbon Dates.

Phase	Site	Hab. area (ha)	House and storage structs	Max wall thickness (m)	Max wall height (m)	Total wall length (m)	Number of walls	Altitude	Min. ascent time, 2 km (minutes)	Visible puks within 10 km	Visible puks within 20 km
I	Muyu Pucara (AZ4)	3.5	143	3	2.7	1500	3	4210	39	4	7
	Cerro Toclomaro (P29)	.5		.9	2.3	700	4	3950	36	1	2
	Pichuni Yanaperqa (L2)	1.9		.9	2.4	800	3	3950	31	1	3
average		2.0		1.6	2.5	1000	3.3	4037	35	2.0	4.0
IIa	Apu Pucara (L6)	2.8	232	1.75	2.3	2500	7	4220	44	4	7
	Cerro Pucarani (N2)	18		4.6	5.65	2100	2	4300	52	1	8
	Pichuni Yanaperqa (L2)	1.9		.9	2.4	800	3	3950	31	1	3
	Llongo (S4)	4.8		1.8	3.4	2200	7	4010	35	0	7
	Cerro Sinuchache (CA2)	7.6	555	2.5	1.8	360	4	4200	44	1	4
	K'askawi (AS5)	3.1	158	1.9	1.5	1900	3	4040	33	3	5
	Calvario de Asillo (AS1)	5.6		1.5	1.9	3150	4	4120	37	5	13
	Cerro Mallacasi (PKP7)	2.1	30	2.8	4.7	1000	3	4260	49	3	6
	Ch'unchu Pucara (AZ1)	9.8		4	4.2	2600	5	4090	39	6	14
average		6.2		2.4	3.1	1846	4.2	4132	40	2.7	7.4
IIb	Cerro Monos (J10)	3.5		2.2	2.5	900	1	4130	38	3	4
	Cerro Mugra (J11)	2.1		2.1	3.4	800	4	4060	42	2	3.0
	Calvario de Asillo (AS1)	5.6		1.5	1.9	3150	4	4120	37	5	13
	Cerro K'ajro (AS3)	8.2	324	2.3	2.9	5950	3	4120	35	8	11
	Cerro Pucarani (N2)	18		4.6	5.65	2100	2	4300	52	1	8
	Kojra Chico (PKP2)	.7		3	4.5	200	3	4080	41	3	6
	Muyu Pucara (AZ4)	3.5	143	3	2.7	1500	3	4210	39	4	7
average		5.9		2.7	3.4	2086	2.9	4146	41	3.7	7.4

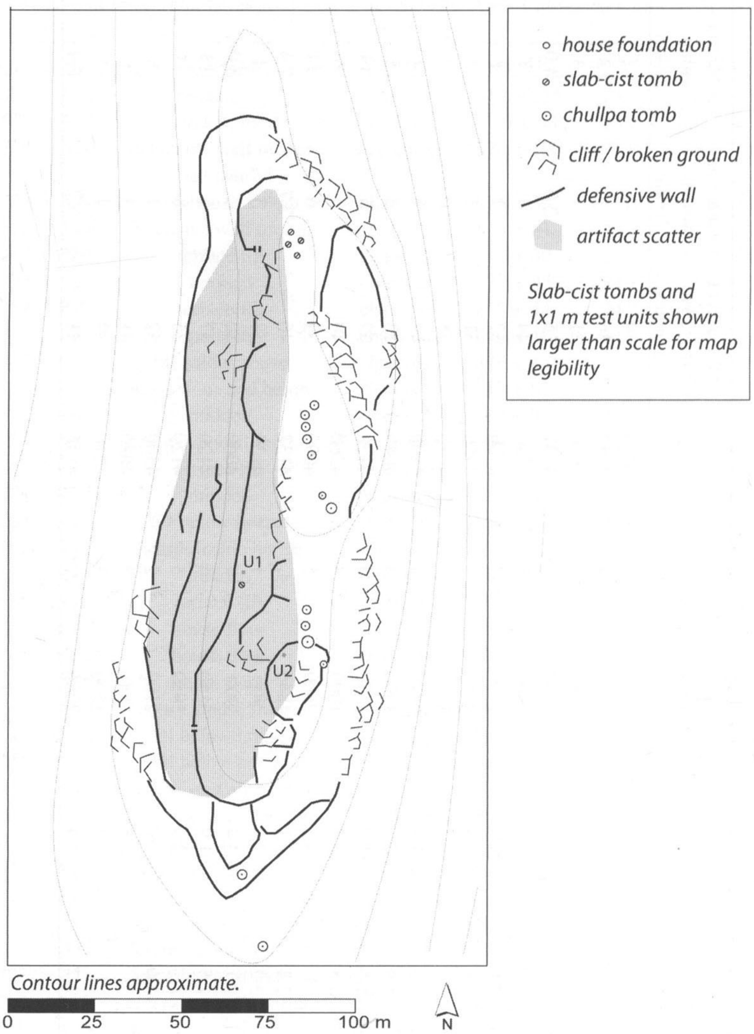

Figure 3. Cerro Toclomaro (P29).

size, wall height and thickness, and landform accessibility.[5] All indices of defensibility increase over time, but because of the very small sample size of pukaras from phase I, only the change in site size from phase I to II is statistically significant. Here I describe the contrasts between the two phases, and give a few examples of individual pukaras to illustrate.

Phase I: A.D. 1000 to 1275

In the first phase of the Late Intermediate Period, pukara use was minimal. Only three pukaras from the sample of 15 were used at this time, and none of them are large. Cerro Toclomaro (P29) is a small pukara on a low but steep hill just northeast of modern Puno (Figure 3). Relatively low defensive walls supplement a rocky ridgetop where 16 chullpas are perched. No circular house foundations are visible at the site, but there is about .5 ha of dense artifact scatter on the western side of the site, and test-pit excavations encountered a midden. This pukara, which could only have housed a small population, was probably abandoned by the end of this phase, since there is no trace from the surface or excavations of Sillustani pottery, a ceramic type that is common in this area in later phases of the Late Intermediate Period. Second was Muyu Pukara (AZ4), a site on a ridgetop in a chain of high hills northeast of Azángaro, an unusual pukara in several

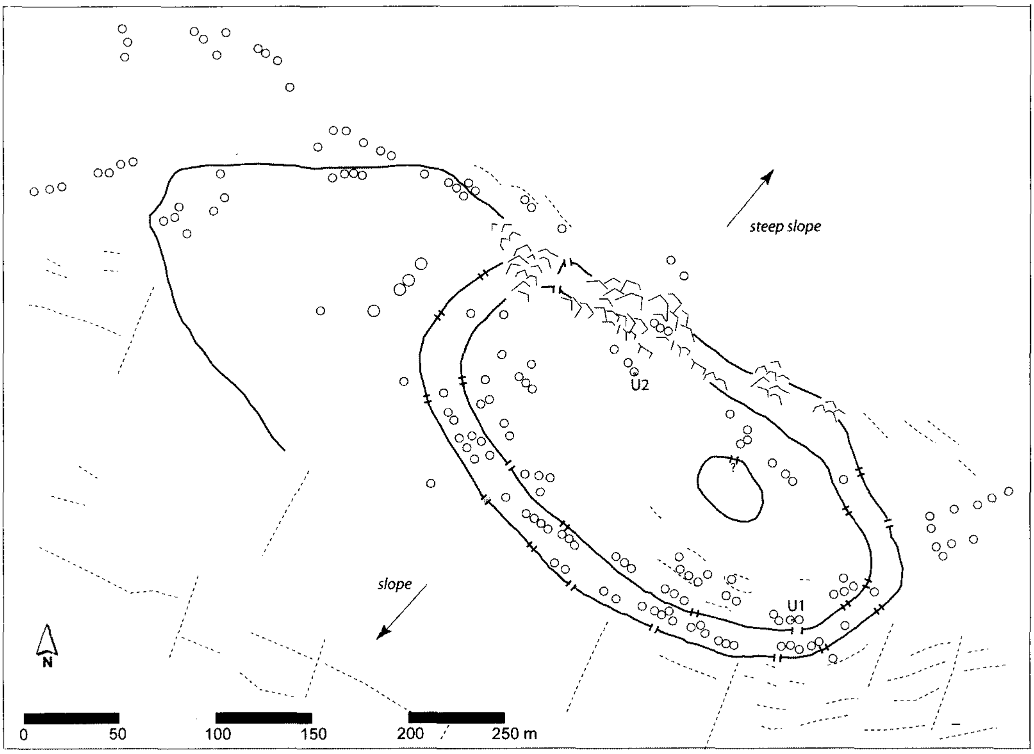

Figure 4. Muyu Pucara (AZ4).

respects (Figure 4). It has over a hundred house foundations in an area of 3.5 ha, protected by well-built defensive walls pierced by numerous doors. However, artifacts are practically nonexistent on the surface, and test excavations inside two houses and in one cleaned house profile found no distinct use surfaces and very few artifacts, suggesting that the site was used only briefly. Nevertheless, it was used more than once: dates from a defensive wall and an ash lens in one house fall in phase I of the Late Intermediate Period, but the site also had at least one later occupation very late in the Late Intermediate Period or Late Horizon. Thus, it is not known how much of the site dates to the early phase. Finally, Pichuni Yanaperqa (L2) is a small pukara with 1.9 ha of artifact scatter on a very low, easily accessible hill southeast of modern Lampa. The walls at the top of the site are the best defined, reaching up to 2.4 m in height. Here, entrances are aligned, an indication that defense was a comparatively low priority at this site, although at some point the higher entrance on the west side was blocked. Dates from this site indicate it was continuously or periodically occupied from some time after A.D. 1200 into phase II of the Late Intermediate Period.

Thus, in phase I there is no evidence of large, strongly defensive, permanently occupied pukaras. A few briefly occupied or less defensible pukaras were used, and the fact that they are spread throughout the survey area suggests that a degree of conflict was present regionally.

Phase II: A.D. 1275 to 1450+

The fourteenth century witnessed an explosion in pukara use and defensive wall construction. At least nine out of the 15 sampled pukaras were in use, with an additional five falling after A.D. 1400. These sites include a wide range of sizes and defensive strengths; four examples illustrate their variability.

Cerro Mallacasi (PKP7) is a small pukara northwest of the town of Pucara with only about 30 house structures dispersed on low terraces across 2 ha (see also Kidder 1943). Nevertheless, the site

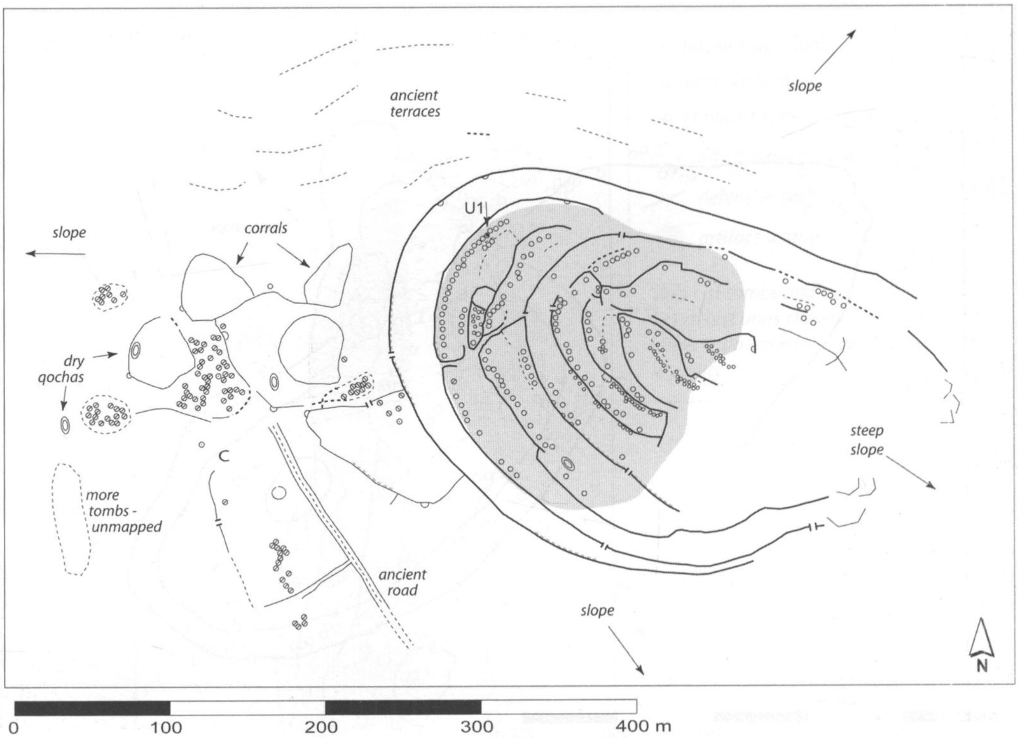

Figure 5. Apu Pucara (L6).

was placed on a highly defensible, steep hill protected by sheer cliffs on three sides. A massive triple wall bars the fourth side. The wall has caches of slingstones, parapets, and small, baffled doorways, one of which was later blocked from the inside. Boulders carved with petroglyphs are interspersed among the houses, and tombs populate the bedrock ridge above. With walls and cliffs that enclose a year-round spring and a large, grassy swale ideal for pasture, this pukara was better equipped than most to withstand a prolonged siege. The great disproportion between the size of the defensive walls and the handful of houses at this pukara suggests that non-site residents must have helped build the walls, unless the construction dragged on for decades.[6] The pukara probably offered a refuge to nearby unfortified populations who participated in its construction and maintenance.

Apu Pucara (L6) is a pukara of medium size on a high, steep hill west of Lampa (Figure 5). To the east is a steep, rocky drop; seven concentric walls line the other sides. On the west side of the site, the principal gate is flanked by inset walls about 2.1 m high and furnished with parapets. The gate opens into a walled path that leads to the top of the hill, passing between terraces with about 150 house foundations and 75 smaller storage structures. Outside the walls to the west is a wide, flat saddle, with five corrals and six clusters of tombs, suggesting, again, that this defensive community was composed of smaller social segments.

Cerro K'ajro (AS3), situated on a long, rocky ridgetop east of the town of Asillo, is a good example of a large pukara (Figure 6). While the ridge is easier to ascend than most pukara landforms in this phase, the site is protected by three tall walls in good condition, reaching 2.9 m in height and 2.3 m in thickness on the east end of the site where the approach is easiest. This site displays clear evidence of defensive design: parapets, small, nonaligned doorways, and a cache of river cobbles for use as slingstones by the western walls. Inside the walls are 323 circular house foundations in an area of about 8.5 ha covered by dense surface ceramics. Houses on the southern slope are grouped in lines on shallow terraces; those near the ridgetop are associated with several compounds defined by a

Figure 6. Cerro C'acjro (AS3).

single course of boulders, which may have been livestock pens.

Pucarani (N2), the largest and most strongly defended pukara in the survey, is located on and around the sloping peak of a steep massif, protected by cliffs on the north, east, and southeast (Figure 7). Two long, monumental walls defend the western approach, and another wall bars access to the eastern cliff; these walls average 3.5 m high and 3.7 m thick, and reach 5.6 m high and 4.6 m thick at maximum. They are pierced by numerous narrow doors, some of which have small guardrooms built into the walls on one or both sides. A parapet and inner walkway are well defined on the outer western wall, and the walkway is cut wherever a door passes through, creating elevated stations on both sides from which to monitor anyone passing in or out. While only some house foundations and probable storage structures are distinguishable, the surface artifact scatter extends approximately 18 ha over shallow habitation terraces on the sloping mesa and below the eastern wall. If it followed the density distribution of other pukara sites, Pucarani may have included a thousand or more house structures. The spread of dates from this site indicates an extended period of use. The outermost western wall was built just at the beginning of widespread pukara use, in the final decades of the thirteenth century. The southern portion of this wall was built or rebuilt at the very end of the Late Intermediate Period after cal. A.D. 1400, when dates from two test units also indicate the site was occupied.

To summarize, this second phase of the Late Intermediate Period saw the height of pukara use in the northern basin. While some small pukaras such as Pichuni Yanaperqa (L2) and Mallacasi (PKP7) were used, others, such as Toclomaro (P29), had been abandoned, giving way to many medium and large sites with hundreds of houses. These larger sites often have very high, thick walls, and are found on more defensible landforms, indicating an escalation of the threat of attack. At some sites, separate residential compounds or other indices suggest the possible nucleation of smaller social segments. In addition, pukara clustering indicates that pukara inhabitants probably formed defensive coalitions, maintaining social units above the level of the site and thereby allowing some smaller or less defensive pukaras to survive (Arkush 2005, 2009).

Carbon date distributions allow us to see that pukara occupation and construction continued into the very end of the Late Intermediate Period, after cal A.D. 1400. As a group, these late pukaras are not clearly distinct in type or number from pukaras used in the fourteenth century. What they do demonstrate is a sustained level of the threat of violent conflict over a certain time frame. By the end

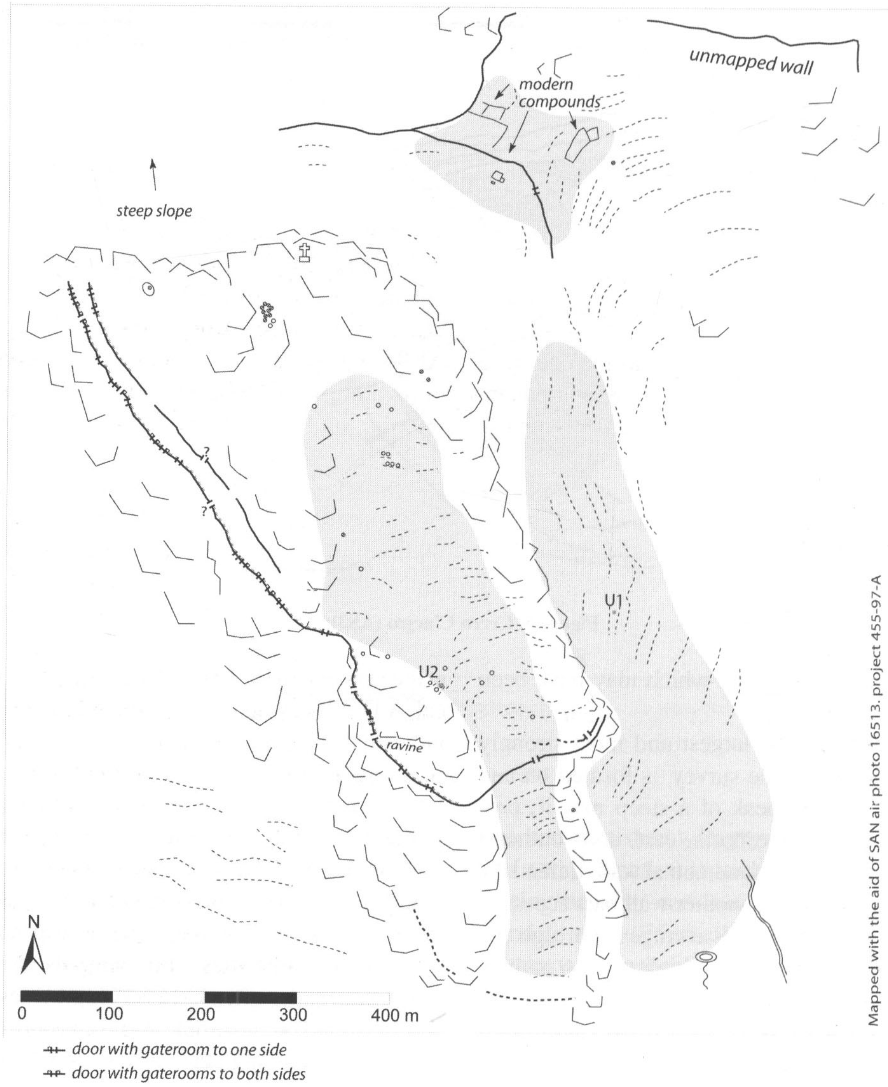

Figure 7. Pucarani (N2).

of the Late Intermediate Period, in the first half of the fifteenth century, the threat of attack on pukara populations had not lessened.

The episodic or extended nature of pukara occupation and construction is suggested not just by the time frame of the carbon dates, but by a number of other clues. There were at least two occupations at Cerro Sinucache (CA2) and Chila (V2), shown by house and wall superpositions. Threshholds and stairways at numerous sites were worn with the passage of people. Multiple wall-building episodes at Pucarani (N2) have already been noted; at Caritani (L1) and Pucara Orqo (AS4), they are indicated by the addition of a new layer to the exterior (dressed) face of a wall to thicken it. Blocked doors in defensive walls are visible at Pichuni Yanaperqa (L2), Mallacasi (PKP7), Kojra (PKP3), Cerro Mugra (J11), and Cerro Pucara (V3). These later improvements to fortifications suggest not only long-term or episodic use, but that the perceived level of threat remained high over time. Not every site remained a reliable stronghold to be reused later, however. As has been noted, at least one site (Toclomaro, P29) was abandoned by the second phase of the Late Intermediate Period, and walls at several sites may have been intentionally destroyed.[7] While the local histories of individual pukaras cannot be wholly untangled at this point, it is clear that pukara use was a process, not a brief event. The threat of violent attack waxed and waned over the course of several generations. Through victories and defeats, forts endured to be used again by those who could control them.

Swords and Ploughshares: Pukaras in the Late Horizon

The very late range of dates such as the one from Muyu Pukara (AZ4) brings up the issue of pukara use at or after the Inca conquest. Late Horizon use appears to have been the exception rather than the rule: distinctive Inca-period ceramics are plentiful in the Titicaca Basin generally, so the paucity of them at Colla pukaras suggests that most pukaras were abandoned in the Late Horizon. Large pukaras are often found near Late Horizon centers like Asillo, Lampa, Nicasio, and Vilque, and probably supplied their original population.

However, some late, attenuated occupation or burial is indicated by Inca-period chullpas or ceramics on at least seven out of the 44 pukaras. For instance, small but significant amounts of Late Horizon ceramics are found at the sites of Cerro Pucarani (N2) and Mallacasi (PKP7) described above. It is intriguing to speculate whether such material is related to the defensive use of pukaras at the time of the Inca invasion, or in the rebellion that, according to the chronicles, took place afterwards in the Colla area at false news of the Inca's death. The chroniclers state that the rebellion took some time, perhaps years, for Topa Inca's army to quell, and they name specific pukaras used (or reused) by the rebels in this uprising: Pucará, Llallagua, Asillo, and Arapa (Betanzos 1996:144–146 [1551–1557: Pt. 1, Ch. 34]; Cabello 1951:336 [1586: Bk. 3, Ch. 18]; Murúa 1986:89 [1613:Bk. 1, Ch. 24]; Rowe 1985:213–214; Santa Cruz Pachacuti 1993:234–236 [1613:26–27]; Sarmiento 1988:130 [1572:Ch. 50]). Most of these rebel pukaras can be identified, except for the case of Arapa. Calvario de Asillo (AS1) was almost certainly the rebel fort of Asillo, being the largest and closest pukara to the town, while "Llallagua" must have referred to at least one of the pukaras in the complex of four (PK1-4) on a massif south of Pucará, itself named for the rebel stronghold on the crag above (PKP5). There are unusually late dates for wall construction events at both Calvario de Asillo (AS1) and Cerro Kojra Chico (PKP2) at Llallagua, and possibly these dates correspond to the Colla rebellion.

Inca architecture is also present at a few pukaras, attesting to a presence that was probably official and that illuminates Inca strategies of incorporation and governance of this bellicose region (Figure 8). These architectural complexes are located, again, on the rebel strongholds of Llallagua and Asillo. There was a considerable Inca investment in architecture at the Llallagua hill range, with four Inca installations, one on or close to each fortified peak. The largest is a complex of niched rooms around a courtyard on the Llallagua peak proper, first described by Rowe (1942), who proposed that the structure was an Inca garrison. In addition, two niched rooms with a patio and enclosed bedrock platform are found on the secondary peak of Cerro Kojra, a small group of masonry-retained platforms overlooks the approach to Cerro Kojra Chico from Llallagua's peak, and finally, there is a poorly preserved compound of rectangular rooms around a patio on the lower, lightly fortified peak of Quijache. Niches, rectangular layouts, and shaped masonry identify these structures as Inca. At Calvario de Asillo (AS1), the Inca architectural group is located on a saddle to the east of the fortified peak, in an area that may have held ceremonial significance in the Late Intermediate Period, with several petroglyphs and a large circular enclosure. It is larger and more complex than the structures on Llallagua, and includes a facade with double-jambed niches on one side and simple niches on the other side. This set of structures is especially interesting because the impression it gives is of a ceremonial complex, rather than a garrison. Double-jambed niches and doors are extremely rare in the Titicaca Basin, with the most salient exception being the major temple complexes on the Islands of the Sun and Moon. In this light, the function of the Inca structures on Llallagua could also be reconsidered.

The most important of the rebel pukaras was Pucará itself, and here the Incas also made a significant building investment, not on the fortified peak, but in alterations to the Formative period ceremonial site at the base of the peak. Topa Inca incorporated Pucará and Asillo (and possibly Llal-

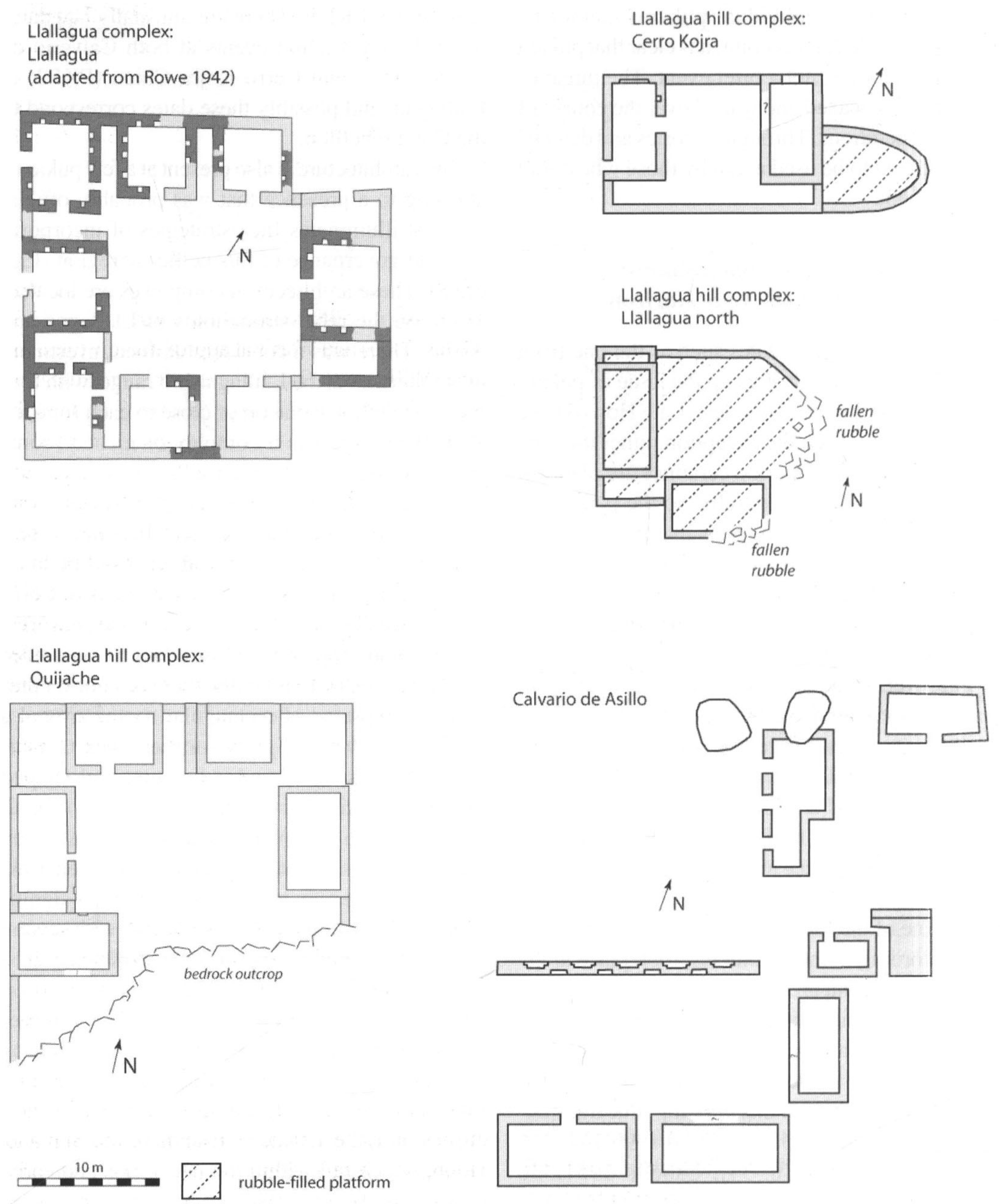

Figure 8. Inca architectural complexes on Colla pukaras.

lagua) into a royal estate after vanquishing the Colla rebels (Rostworowski 1970:162), so Inca structures and modifications may have been built as an improvement to these royal holdings. In sum, the juxtaposition of Inca structures with Colla rebel pukaras reveals an Inca response to the insurrection that was interestingly multifaceted: military reconquest, the establishment of direct administrative control as part of a royal landholding, and the symbolic appropriation or neutralization of rebel forts through the building of ceremonial structures.

Discussion: The Course and Causes of War in the Titicaca Basin

While the evidence indicates complex local histories of pukara construction, use, and modification, across the Colla region there was a dramatic escalation of the threat of war in the fourteenth century. Fort use and wall construction continued apace after ca. A.D. 1400, while the defensive strength of forts remained the same or increased. Two fort dates probably fall after cal A.D. 1450 and may correspond to the Colla rebellion.

What caused the intensified war of the fourteenth century? Whatever it was, it stretched far beyond the Titicaca Basin, for regional studies in several other parts of the southern and central Andes bear a telling resemblance to the Colla sequence. In the upper Mantaro basin of the south-central Andes, defense was already a concern in the early Late Intermediate Period, but warfare apparently intensified after A.D. 1300, when Wanka populations congregated in much larger, higher-altitude settlements behind thick walls (D'Altroy and Hastorf 2001; Earle et al. 1980 1987; Hastorf et al. 1989). Likewise, in the upper Moquegua valley, some Tumilaca populations of the early Late Intermediate Period built fortified settlements, signaling a concern with warfare, but nearly all sites from the succeeding Estuquiña period, dating after cal A.D. 1200 (with the majority after cal A.D. 1300), were fortified and defensibly located (Owen 1995; Stanish 1985, 1992). Warfare and fortification in the far southern Andes was clearly a late phenomenon. Nielsen's (2002) dates from pukaras in the Altiplano de Lipez in Bolivia's southern highlands correspond closely to the height of Colla pukara use, with five out of six falling between cal A.D. 1300 and 1400. To the south, pukaras near Chile's Loa Valley and the Salar de Atacama date to the end of the Late Intermediate Period, after cal A.D. 1300 (Uribe 2002). In northwest Argentina, settlements moved to more defensible and partly fortified positions after A.D. 1200, reaching a height in the fourteenth century (Nielsen 2001). Studies of individual pukaras also usually yield dates in the latter half of the Late Intermediate Period, as at the Titicaca Basin forts of Cutimbo (Frye and de la Vega 2005:178) and Pucarpata (Pärssinen 2005), to the south of the study area. It is intriguing that these developments occurred in such far-flung regions at about the same time. While more dates are needed from the central and northern Andes, the oft-mentioned warfare of the Late Intermediate Period seems to be mainly a phenomenon of the *late* Late Intermediate Period. Consequently we must reconsider the explanations for it.

Collapse

Recent reevaluations of dates indicate that Tiwanaku's collapse occurred around A.D. 1000 (Owen 2005) and Wari's at approximately the same time (Williams 2001). If the extensive fortification of the Titicaca Basin and the broader Andean highlands was a direct result of the collapse of the Middle Horizon states, it should have occurred in the first few generations afterwards. Clearly this was not the case in the northern Titicaca Basin. While the use of a few small and less-defensive pukaras early in the Late Intermediate Period indicates a degree of conflict, most fortification occurred after a delay of at least two centuries. We can consider political collapse to have been a precondition that allowed endemic warfare to occur. However, another explanation is needed for the marked escalation in warfare in the late Late Intermediate Period.

Invasion

If not a result of collapse, were pukaras a response to Inca aggression? Colla pukaras arose and became widespread significantly earlier than the Inca expansion, if we adhere to Rowe's (1945) conventional chronology, which places the Inca conquest of the Titicaca Basin at around A.D. 1450. This timing is supported by radiocarbon dates from the Inca shrines on Lake Titicaca's Islands of the Sun and Moon, which fall within the late 1400s and early 1500s with 1-sigma ranges after about cal A.D. 1420 (Bauer and Stanish 2001:251–255), as well as by dates from Estuquiña-Inca and Inca sites in the upper Moquegua Valley, also falling in the fifteenth century (Stanish and Rice 1989:8; Stanish 2003:208). However, fourteenth-century dates for strata with Inca ceramics from Caquiaviri south of Lake Titicaca (Pärssinen and Siirriäinen 1997) suggest conquest was preceded by contact and exchange with Cuzco. Possibly, unsuccessful Inca military forays took place as well.

However, pukaras are pervasive throughout the Titicaca Basin, even in parts much farther removed from the Inca threat than the northern Colla area, such as the southern Lupaca zone. In addition, pukara use spanned at least 200 years, and some sites witnessed extended use. Thus, while some of the later pukara dates may correspond to the Inca invasion or the Colla rebellion, it is unlikely that most pukaras were built to guard against Inca incursions.

A more plausible explanation could be an Aymara invasion hypothesized by linguists and ethnohistorians, who have argued that the relative uniformity of the Aymara language indicates that it was a late arrival to the Titicaca Basin (Albó 1987; Bouysse-Cassagne 1987; Cerrón-Palomino 2000; Espinoza 1980, 1987; Torero 1987, 1992; see Browman [1994] and Stanish [2003:222–223] for overviews). Alfredo Torero (1987, 1992) is the main proponent of this idea, suggesting that Aymara-speaking migrants displaced indigenous Uru and Pukina-speaking peoples who had been responsible for earlier cultures in the Basin, including Tiwanaku. While originally proposing that this influx occurred at Tiwanaku's collapse, he later revised the timing to ca. A.D. 1200, interpreting the Lupaca-Colla rivalry that the chroniclers describe as a conflict between invading Aymara and native Pukina speakers. (Most Titicaca Basin archaeologists do not subscribe to Torero's hypothesis, citing continuous site occupation and long-term stylistic continuities [Albarracín-Jordán 1996; Browman 1994; Stanish 2003; Stanish et al. 1997]). If pukaras were the result of an Aymara migration into the region, the migration must have taken place in a complex patchwork that caused pervasive conflict throughout the Titicaca Basin, rather than resulting in a single, archaeologically visible frontier.

The main weakness of both early Inca incursions and an Aymara migration *as causes of warfare* is that they are too local, failing to address the very large scale of fortification and defensive settlement in the Andean highlands in the Late Intermediate Period. If an Aymara migration is seen as only one of a number of population movements and displacements taking place at this time, the question is simply pushed back one step: why was this a time of extensive migration? To satisfy the scale of the problem, the migration hypothesis must be reduced to an intermediary step from other explanations.

Environmental Change

Environmental crisis and resource scarcity—particularly drought—is an attractive explanation because it applies well to the scale of the problem. Precipitation is an extremely important factor in agricultural production in the Titicaca Basin: the terraced hillside and hill-base fields are primarily dependent on rainfall and runoff rather than irrigation from permanent springs or rivers. Early Colonial observers in the altiplano noted a deep concern with crop shortages and famine in years of low rainfall (Cieza 1984:272 [1553]; Diez 1964:147, 163, 175 [1567]; Polo de Ondegardo 1990:61 [1571]), and recent research confirms that precipitation strongly affects altiplano potato yields (Garreaud and Aceituno 2001; Orlove et al. 2000:71).

Precipitation in the Titicaca Basin, like the rest of the southern Andes, depends mainly on northeasterly winds from the warm, humid Amazon Basin during the austral summer from December through March. It is highly variable from year to year and on longer time scales. It is substantially lower during severe ENSO episodes (El Niño—Southern Oscillation) (Roche et al. 1992), it oscillates independently on a interval of about 13 years (Melice and Roucou 1998), and longer periods of alternating drought and high rainfall are documented by ice cores and lake cores (Abbot et al. 1997; Baker et al 2001; Thompson et al. 1985, 1986, 1998). Evidence from cores of the Quelccaya ice cap, just north of the Titicaca watershed (Thompson et al. 1985), supported by sediment cores from Lake Wiñaymarka, the smaller lake at the southeastern end of Lake Titicaca (Abbot et al. 1997), indicate an extended drought period during the Late Intermediate Period. Binford and colleagues (1997) estimate that precipitation during this episode was 10 to 15 percent lower than modern levels, and lake levels dropped by 12 to 17 m. Such a drought would have posed an unprecedented challenge to the farmer-herders of the altiplano.

How well does this drought correlate with pukara use? According to the lake cores, a hiatus indicating a low lake stand occurred at some point in time between A.D. 1030 to 1280, with the return of shallow water by about A.D. 1350, and deeper water about a century later (Abbott et al. 1997). Oxygen isotopes in ostracods record the balance

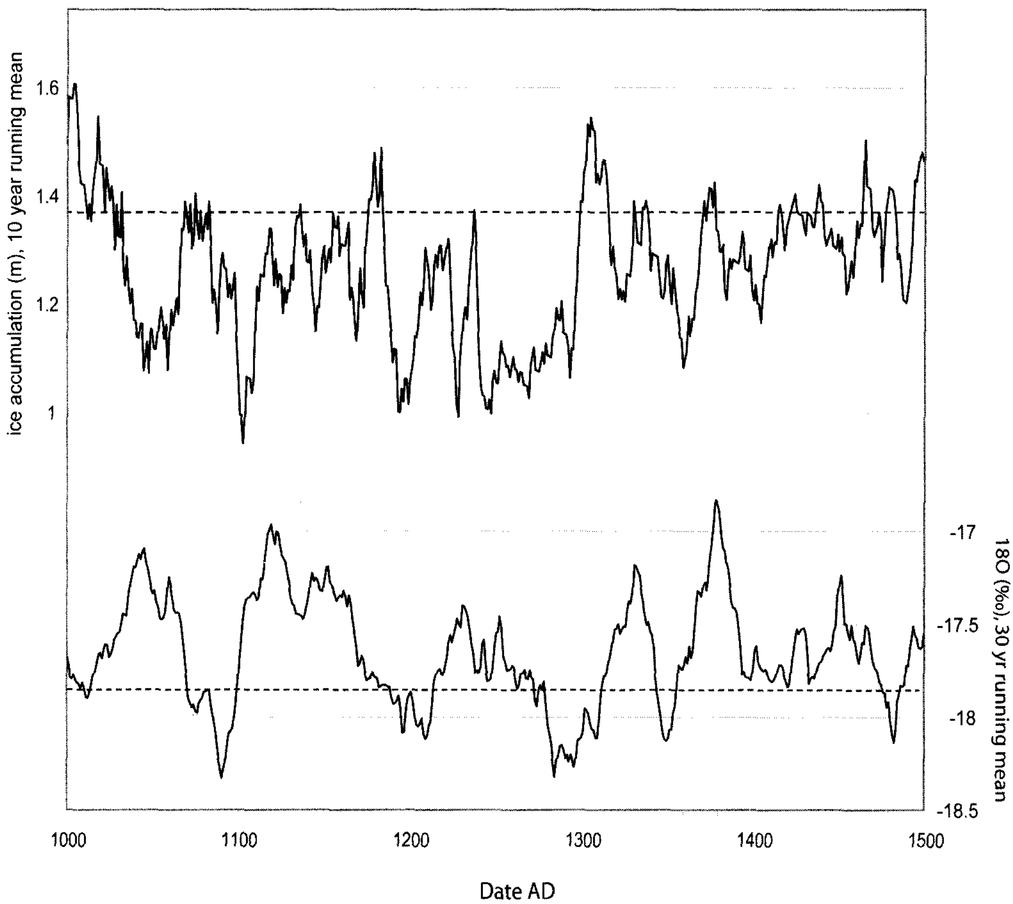

Figure 9. Quelccaya core 1 ice accumulation (above) and $\delta^{18}O$ (below) for A.D. 1000–1500. Data from Thompson (1992). Trend lines show moving average. Dotted lines indicate averages for entire core sequence.

of evaporation and precipitation, and likewise indicate dry conditions after the hiatus until about A.D. 1400 (Binford et al. 1997). Unfortunately, the onset of the low lake stand cannot be dated directly, because the lake core sediments were eroded while exposed in the drought.

The Quelccaya glacier cores, with their annual resolution, provide a much more precise chronology than the carbon dates that form the basis of the lake core chronology, but their interpretation is more problematic. Thompson and the many archaeologists drawing on the Quelccaya data (e.g. Moseley 2002; Ortloff and Kolata 1993; Shimada et al. 1991; Williams 2002) use ice layer thickness as an index of precipitation, and draw primarily on the accumulation sequence from core 1. By this measure, core 1 indicates that the period between about A.D. 1240 and 1310 was a drought of exceptional length and severity (Figure 9; Thompson et al. 1985:973). It would have coincided with the very beginning of most pukara use in the northern Basin (Figure 10). However, pukara use would have mainly occurred *after* the drought eased, in the fourteenth and fifteenth centuries. This correlation should be considered tentative, because the physical measurement of ice layer thickness is prone to error (Calaway 2005; Melice and Roucou 1998).[8]

The Quelccaya cores also record oxygen isotope ratios ($\delta^{18}O$), which reflect temperature over Amazonia and the tropical Pacific sea surface temperature as well as precipitation over the Amazonian basin. The degree to which one or the other factor affects isotope ratios on short and long time scales is imperfectly understood (Baker et al 2001; Hastenrath et al. 2004; Hoffman et al. 2003; Thompson et al 2000, 2003; Vuille et al 2003); temperature is the dominant factor on very long (e.g. millennial) time scales, while variability on decadal time

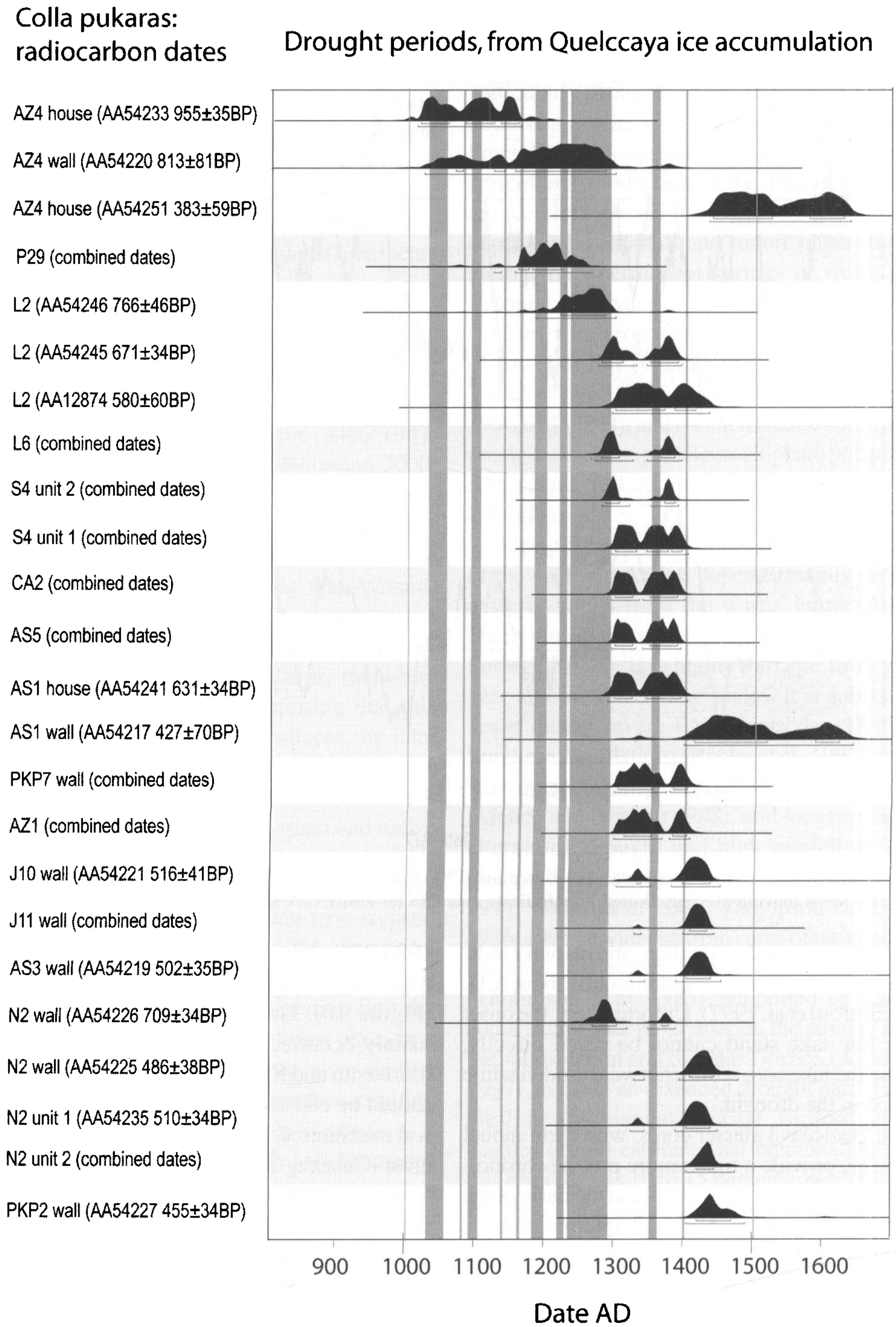

Figure 10. Comparison between pukara dates (black shapes) and peak droughts (vertical gray bars), as indicated by Quelccaya ice accumulation, core 1 (Thompson 1992). Droughts are defined as years in which the 10 yr running mean < avg – 1σ for whole core sequence.

scales appears more affected by precipitation. For instance, for the relatively short time period since 1915, levels of Lake Titicaca correlate more closely to changes in $\delta^{18}O$ in the Quelccaya cores than to ice layer thickness (Baker et al. 2001; Hastenrath et al. 2004; Melice and Roucou 1998; Rigsby et al. 2003). Oxygen isotope values from the Quelccaya core 1 are shown in Figure 9; higher (less negative) values should correspond to drier conditions on short time scales. By this measure, dry and warm conditions prevailed throughout most of the Late Intermediate Period, including droughts from about 1305 to 1380 during most of the first phase of pukara occupation, suggesting a more direct link between pukara use, resource stress, and resource unpredictability (Figure 11).

One final line of evidence is the Miraflores flood, a severe ENSO event in the early to mid-fourteenth century, evident in flood deposits from the Casma, Moche, and Moquegua Valleys (Magilligan and Goldstein 2001; Reycraft 2000; Satterlee et al. 2000; Wells 1990). Because ENSO events are associated with severe drought in the altiplano, the Miraflores flooding may also indicate a drought crisis at some time soon after A.D. 1300.

While the climate sequence in the south-central Andes is still rather poorly understood, multiple lines of evidence suggest dry periods in the later thirteenth and fourteenth centuries, a situation that would have resulted in frequent yet unpredictable crop failure. Climate change therefore appears to be a persuasive explanation for the escalation of warfare in the fourteenth century. This is the more convincing because of large-scale correlations in the timing of fortification and defensive settlement across the southern and central Andes. Nevertheless, the construction and use of Colla pukaras continued into the 1400s, when lake cores, ice accumulation, and oxygen isotopes from Quelccaya *all* suggest that precipitation was more plentiful. After its initial impetus, warfare and fort-building must have continued for other reasons.

Does this sort of environmental explanation verge on environmental determinism, as Erickson (1999, 2000) cautions? Erickson's emphasis on the resilience and ingenuity of Andeans in adapting to their dynamic, unpredictable environment is unassailable. But violent actions, too—raiding for stores and livestock, or attacking other communities to drive them from coveted lands—had a place in the arsenal of Andean peoples in dealing with adverse conditions. These aggressive strategies were not *determined*, but they had a powerful momentum of their own: if some groups chose them frequently enough, others would have been compelled to follow, or face unrelenting depredations.

Warmongering, Fortified Landscapes, and Durable Antagonisms

Another kind of explanation is needed for the perpetuation of warfare in the northern Titicaca Basin in the fifteenth century, a time of ameliorated climate: why, once the Pandora's box of warfare was opened, could it not be stuffed back in again? A number of possibilities may be raised, though they are somewhat conjectural at this point.

First of all, local sinchis may have profited from encouraging war, as in the Wanka area. Sinchis derived their preferred status from war leadership, and must have found an extended climate of hostility more conducive to their ends than peace. The chronicles hint at this by attributing wars and warmongering in the Titicaca Basin to particular leaders, and by suggesting that the rewards of victory went first and foremost to sinchis, not to fighting forces or whole communities. For instance, Cieza states the Colla paramount lord Zapana and his heirs "won many spoils in battles, which they gave to the people of the district" (1984:279 [1553]). Here, warfare appears to solidify the hierarchical relationship between a Colla sinchi and his people through the redistribution of spoils.

Second, the potential of fortifications to themselves create durable landscapes of war should not be underestimated. Fortifications in balkanized regions such as this one, because they give strength to the defenders, make conquest, regional consolidation, and the achievement of lasting peace difficult. Colla pukaras must have been particularly effective because two of the most useful offensive tactics against fortifications—prolonged sieges and surprise attacks—were apparently rare or impossible. The lack of year-round water sources on most pukaras suggest prolonged sieges were beyond the logistical capabilities of Colla societies, and the commanding views of pukaras in the treeless terrain of the altiplano would have prevented most surprise attacks by large war parties. Hence, pukaras thwarted conquest and may have encouraged local

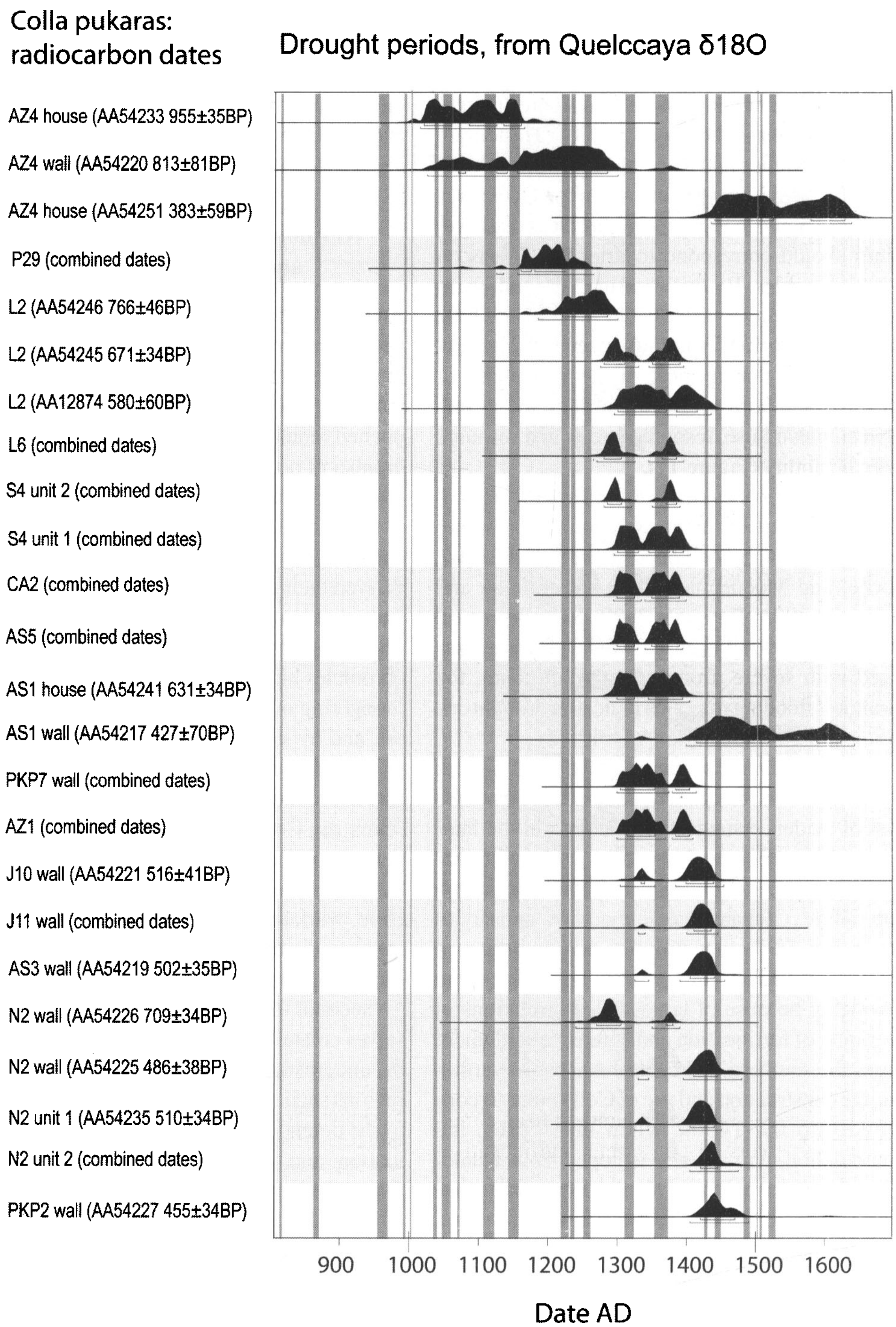

Figure 11. Comparison between pukara dates (black shapes) and peak droughts (vertical gray bars), as indicated by Quelccaya $\delta^{18}O$, core 1 (Thompson 1992). Droughts are defined as years in which the 10 yr running mean > avg + 1σ for whole core sequence.

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groups to remain semi-independent and potentially aggressive. Perhaps the best indication of this dimension of pukaras is their reuse in the Colla uprising against the Incas. Indeed, their simple existence may have encouraged the decision to rebel. Just as Erickson (2000) considers the accumulated patrimony of raised fields, hillside terraces, improved qochas, and managed bofedales to be part of Titicaca Basin Andeans' "landscape capital," so too pukaras, once built, became a kind of landscape capital, already in place for the defense of local communities against whatever enemies they might have or make.

Third, the logic of segmentary social organization, in which the killings of individuals are seen as group offences demanding group vengeance (Kelly 2000), may have encouraged vendettas and facilitated the conscription of related groups into larger-scale conflicts. Persistent histories of antagonism were materialized on the landscape in clusters of defensive settlement and buffer zones, and the largest-scale enmities were remembered in oral histories of conflict between Collas, Lupacas, and Canas, eventually recorded by the chroniclers. Just as Late Intermediate Period fortifications were reused by later generations, the memories of past hostilities remained long after the Late Intermediate Period had ended, and could be stirred up again expediently: shortly after the Spanish conquest, Lupacas took the opportunity of weakened central control to attack Colla settlements (Hemming 1970:242). The escalated violence of the fourteenth century left a wake of bloodshed far beyond its initial impetus.

Conclusions

Colla warfare can be best understood from a multicausal framework of constraints and incentives operating at different scales. The chronology of fortification in the northern Titicaca Basin correlates with a number of other regions in the central and southern Andean highlands. Together, these cases demonstrate that while the collapse of the Middle Horizon states set the stage for limited factional conflict in the early Late Intermediate Period, other factors contributed to a horizon of violence centuries later. This sequence suggests that warfare is a possible, but not an inevitable, result of state collapse. In the central and southern Andes, people negotiated local intergroup relationships with only limited conflict for at least two centuries in the wake of a disintegration of state authority that must have significantly reordered these relationships.

It is highly probable that drought and attendant resource stress played a significant part in the escalation of war in the late Late Intermediate Period. Resource stress could have fostered violent competition for limited arable land, and encouraged raids on stored crops; it may have indirectly led to livestock rustling as people became more reliant on camelids, or perhaps it simply caused greater social friction between neighboring communities in hard times. Nevertheless, in the Titicaca Basin, fort-building continued after the droughts eased, suggesting that warfare outlived this impetus and generated its own momentum. Good times did not result in peace any more than collapse resulted in widespread war. The causes of continued war are difficult to pinpoint securely, but power-hungry warlords, durable fortifications, and the cycles of revenge encouraged by segmentary organization may have embroiled the Collas in periodic wars for the rest of the Late Intermediate Period and beyond.

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Notes

1. A house probably did not equal a household. At the time of Viceroy Toledo's census in 1570, about two centuries after the occupation of pukaras, there were about 3.5 women, children, and elderly or non-tribute-paying men per tributary adult man in the Colla region (Toledo 1975). This suggests that a nuclear Colla family of the early Colonial period included about 4.5 people. If sex and age distributions were similar in the Late Intermediate Period, a minimal household would surely have required more than one house structure 3 m in diameter. Indeed, houses are most commonly found in groups of two to four on a terrace.

2. Pukaras are preferentially located so that a number of other pukaras are in view, and may have used visual signals to communicate with each other in wartime.

3. "Pucararo phatticatatha, maricatatha: Acogerse huyendo a la fortaleza, o castillo" (2.275); *pucara maquipatha*, defined as both "to surrender a fortress" (1.245, 2.275) and "to take over *(entrar)* a fortress" (1.219); *pucara tikhratha, chhichhitha, ccoccotha*, and *huakhillitha,* all meaning to destroy a pukara (1.245, 2.275). These terms are Aymara, not Spanish- or Quechua-influenced neologisms.

4. Across the whole sample, straw from wall mortar yielded slightly later dates than wood charcoal from excavation units in occupation deposits. At individual sites, however, when both straw and charcoal samples were dated from the same site, they did not differ in a consistent fashion; for instance, at Pucarani (N2), charcoal dates were about the same or later than straw dates. This suggests that wood curation is not a major source of error. A possible explanation for the generally late dates from straw is that walls were built or repaired after the initial occupation of pukaras. For example, dates from straw from two different parts of the main outer western wall at Pucarani (N2) are 30 years apart at the very least (1-sigma) and suggest that this wall was built in at least two separate episodes. Nevertheless, it is possible that wood curation may result in artificially early dates for some terraces and occupation strata. Charcoal dates should be seen as representing the earliest probable dates for occupation. This bias serves to emphasize the overall pattern of carbon dates, of consistently late pukara construction and occupation.

5. Mimimum ascent time was calculated with a GIS analysis of a digital elevation model (DEM) from ASTER satellite data in ArcGIS 9, using the path distance function, which calculates the least cost anisotropic path from a group of source points to any other cell on a raster. Here, source points were defined as cells a minimum of 2 km from the pukara that lay on the plains—i.e., with an altitude at or less than 4,000 m and a slope at or less than 5 degrees. The cost of the path was calculated from the DEM in minutes of walking time using Tobler's hiker function (Tobler 1975). While the resulting ascent times correlate well with the actual times it took to ascend each pukara in the field, they should be considered more reliable, because in the field we ascended pukaras from different distances, depending on where the modern road lay.

6. Drawing on the estimates of Kolb (1991) and Emerson (1965) for the Hawaiian and Mayan areas respectively, I use a rough estimate of 4.5 person-days per cubic meter of wall (including rubble fill). For the workforce, we can make a very crude estimate of one wall-builder for every two houses on site: this assumes that a minimal nuclear family used two houses on average, but could only field one able-bodied adult for wall building. The resulting ratios range from 14 days of labor per resident wall-builder (at Sinucache, CA2) to about 2,000 (at Mallacasi, PKP7), with a median of 245. These estimates should be considered very rough, since variables such as the quality of wall masonry varied from site to site, but they give an idea of the range of variation.

7. This hypothesis was initially suggested by Rowe (1942) in his analysis of two pukaras near the town of Pucará (Incacancha, PKP5 and Llallagua, PKP1), both of which have defensive walls in unusually poor condition. The idea that late

prehispanic warfare in this region may have included the destruction of pukaras is indirectly supported by Bertonio's Aymara phrases (note 3).

8. Measuring ice layer thickness is especially difficult for earlier years lower in the core, where the ice is compressed and yearly sections are much thinner. Consequently, ice accumulation values do not correspond well between the two separate ice cores from Quelccaya before about A.D. 1300. Oxygen isotope ratios should be resistant to this source of error, and they do match between the cores, but before about A.D. 1300 an increasing offset between the two curves indicates a chronology problem with one or both cores. This problem does not substantially affect the dating of droughts close to the pukara time frame, and hence is not given further discussion here (see Arkush 2005 for a fuller treatment).

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