



Wari across the Andes: Modeling the radiocarbon evidence

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ABSTRACT

The expansion and impact of the Wari polity across the Andes has been heavily debated by scholars over the past two decades. We use radiocarbon dates, Bayesian statistics, and contextual data from several Andean regions to review the chronology for Wari expansion, political reorganization, and impact on local settlements. We recognize that Wari political and economic influence will vary in space and time and present a model that addresses how influential moments (expansion, reorganization, collapse) in Wari's trajectory may or may not have had broader impacts across the landscapes of its peer polities. Our model, while not completely comprehensive, draws on both Wari's presence in the north highlands and in the south, where scholars have argued for distinct trajectories and character of Wari influence. It also examines data from local communities in these same regions contemporary with identified Wari settlements, but perhaps without outward indicators of Wari hegemony, to evaluate broader patterns in Middle Horizon settlement through the latter half of the first millennium CE.

1. Introduction

Since the Wari phenomenon was identified as a distinctive entity from the Tiwanaku polity and the “coastal Tiahuanacoid” style nearly 75 years ago (Rowe et al., 1950; 1956; Tello, 1942), scholars have debated the nature and chronology of Wari expansion across the Andes (i.e. Schreiber, 1992; Jennings et al., 2022; McEwan and Williams, 2012). This period in Andean prehistory, known as the Middle Horizon based on the John Rowe master chronology, was a time of dynamic restructuring of interregional relationships. We build on these syntheses by taking a pan-Andean regional approach to Wari radiocarbon chronologies to assess Wari affiliations regionally. This settlement-based approach, incorporating Bayesian analyses where possible, helps to highlight the variation in Wari expression through space and time. We then examine several cultural traditions and Wari state institutions through the lens of radiocarbon data to assess the appearance and duration of these institutions in the archaeological records over the multiple regions in the study.

2. A regional approach to Middle Horizon wari

In order to assess Wari presence through time, we evaluate each of six regional Middle Horizon radiocarbon chronology as an assemblage of sites and polity interactions (Fig. 1). By examining the characteristics of sites as state installations, Wari-affiliated settlements, and local Middle Horizon sites and dating each set, we can assess which appeared first and relative durations in each place. Within each region, we categorize sites as Wari state installations, Wari affiliated sites, and local sites without evidence of Wari engagement (Table 1). We recognize that these categories may overlap and that Wari state installations may be constructed on or within local sites. Since our goal is to assess Wari regional affiliation, we examine the chronologies of when Wari state installations appear compared to the presence of Wari trade goods or stylistic influence. We also track how local sites without Wari affiliation were occupied during the Middle Horizon in the region. That is, we acknowledge that relationships change through time and across space.

This categorization is not the only method that might be used. Nash

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(2018) argues that relationships between Wari and regional populations might be characterized by direct control, where Wari colonists migrated to and established administrative sites in foreign regions, or indirect control, where local elites were co-opted into Wari hegemony (cf. Schreiber, 1992). Relationships between Wari and other groups may also be characterized as interaction without political hegemony or influence, where there was no direct contact between Wari agents or local people. Even in the latter case, stylistic conventions from Wari sources may be carried into local crafts (e.g. Grávalos et al., 2023). “Interaction” characterized the relationship between Wari and Tiwanaku on the

Moquegua frontier, for example, while certain parts of the Central Coast of Peru have been described as Wari “influenced”, but not under Wari hegemony. The key factor here appears to be “patterned material markers that can be affiliated with state activities or, more specifically, the material evidence of repetitive activities that can be linked to the state’s administration” (ibid.: 482–3).

Here, we attempt to identify those markers of state activities, as well as the engagements with the state that mark those relationships between settlements and the Wari polity reflective of formal economic and political relations. We note that not all sites within a region will express

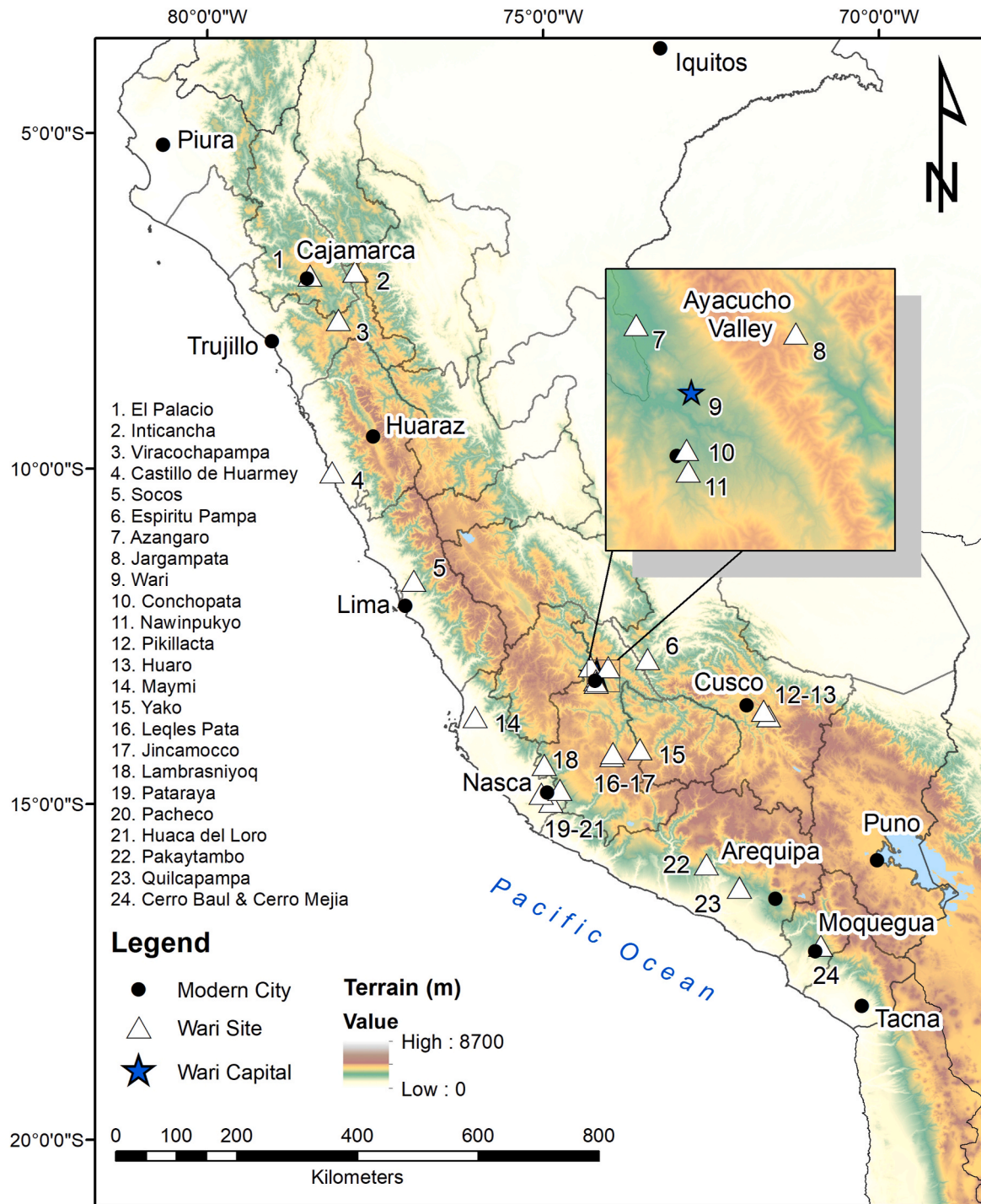


Fig. 1. Map of known Wari centers, significant Wari affiliated sites, and modern cities/regions. The six regions in this study are located around the modern cities/regions of Huaraz, Ayacucho, Cusco, Nasca, Arequipa, and Moquegua.

these relationships, and it is the largest and most well-connected settlements that are most likely to be in formal contact with state institutions outside the region. We also seek to identify those other types of interactions that may reflect formal affiliation with the Wari state, but whose relations may be less directly articulated with Wari state institutions. For us, economic exchange plays a primary role in assessing these relationships of Wari affiliation, as we have noted that increased interdependence on material goods in certain regions is closely affiliated with Wari hegemony (i.e. Williams et al., 2022). Further, we note that certain settlements or subregions may not participate at all in Wari political or economic networks and we seek to document that as well in our regional studies.

Wari state installations are those with one of the hallmark institutions of Wari administration. These include compound architecture of monumental buildings with large plazas and flanking halls, including niched halls and galleries (McEwan, 1998). The presence of D-shaped structures with their accompanying compounds also qualifies a site as a Wari state installation. The D-shaped structure must include the hallmarks of that Wari building, including characteristic sets of niches in the walls and a door that bisects the flat wall, also flanked by niches (Reid, 2023). Major Wari state ceramic offerings, such as those identified at Maymi, Pacheco, and Conchopata (and perhaps Cerro Baúl, cf. (Williams and Nash, 2021) also are considered as a hallmark of Wari state practice at a site. Finally, we also include sites that have the characteristic Wari patio group residential architecture that strictly adheres to the canons of that style. A central square patio surrounded by rooms approximately

2.45 m in width that interlock in the corners is the most typical pattern. Room lengths may vary, but often interchange between a short room of ca. 4–6 m in length to a longer gallery of up to 12 m. We do not include variations of the patio group that are not strictly orthogonal or do not enclose the patio in standardized ways with galleries. Nor do we include settlements with the residential patio group when that pattern was common in the region before the Middle Horizon.

Wari affiliated sites are those that contain trade goods or other evidence of substantial interactions with Wari agents that reflect an interdependence with the Wari state. Some types of classic Wari decorated pottery is the most diagnostic feature, whether produced in the region or elsewhere. Other examples may include arsenic bronzes in Wari style or Wari obsidian lithics like the laurel leaf biface. Wari style textiles also may define a site as Wari affiliated as do other Wari-related trade goods, especially those that do not have local antecedents. These sites may also include architecture derivative of Wari styles, especially when it does not follow local antecedents. Patio group residential architecture, for example, that does not follow a strict orthogonal pattern but is not local may be classified in this category. Ceramic materials that may be derivative of Wari styles even if not strictly Wari may also qualify a site as affiliated in combination with other criteria.

Finally, local sites have Middle Horizon C14 dates and contain architectural and artifactual materials that primarily have local antecedents. Few if any Wari affiliated ceramics or other materials are present. There may be trade goods from adjacent groups or regions, but characteristic Wari-related materials are rare or not represented in these

Table 1

Bayesian modeled radiocarbon phases in six regions of wari influence for three categories of sites and six wari traditions/institutions across the regions.

| Text Section | Region | Wari state n | Starting Boundary | | Ending Boundary | |
|--------------|--------------------------------------|------------------------|-------------------------------------|-----------|-----------------------------------|-----------|
| | | | median cal CE~ | 95% range | median cal CE~ | 95% range |
| 4.1 | Ancash and the North | | | | | |
| 4.2 | Ayacucho heartland | 37 | 700 | 630–770 | 1090 | 1040–1170 |
| 4.3 | Cuzco | 16 | 670 | 510–860 | 1030 | 910–1180 |
| 4.4 | Nasca | 26 | 720 | 640–810 | 1020 | 990–1060 |
| 4.5 | Arequipa | 36 | 820 | 770–880 | 860 | 800–900 |
| 4.6 | Moquegua | 26 | 630 | 560–750 | 980 | 900–1050 |
| Text Section | Region | Wari affiliated n | Starting Boundary median cal CE~ | 95% range | Ending Boundary median cal CE~ | 95% range |
| 4.1 | Ancash and the North | 21 | 630 | 520–710 | 1330 | 1230–1450 |
| 4.2 | Ayacucho heartland | | | | | |
| 4.3 | Cuzco | 17 | 750 | 640–860 | 940 | 790–1040 |
| 4.4 | Nasca | 16 | 690 | 630–770 | 810 | 700–980 |
| 4.5 | Arequipa | 54 | 700 | 650–750 | 1020 | 990–1050 |
| 4.6 | Moquegua | 34 | 720 | 650–780 | 880 | 730–920 |
| Text Section | Region | Non-Wari local MH n | Starting Boundary median cal CE~ | 95% range | Ending Boundary median cal CE~ | 95% range |
| 4.1 | Ancash and the North | 32 | 600 | 540–650 | 1050 | 1010–1120 |
| 4.2 | Ayacucho heartland | | | | | |
| 4.3 | Cuzco | 25 | 590 | 530–640 | 960 | 890–1050 |
| 4.4 | Nasca | 9 | 530 | 420–590 | 740 | 680–890 |
| 4.5 | Arequipa | | | | | |
| 4.6 | Moquegua | | | | | |
| | All regions combined | n | Starting Boundary median cal CE~ | 95% range | Ending Boundary median cal CE~ | 95% range |
| 5.1 | Mortuary Traditions | 46 | | | | |
| | Ashlars ^a | 4 | 850 | 770–960 | 1100 | 1030–1210 |
| | Caves (La Real) | 7 | 680 | 580–770 | 790 | 680–920 |
| | Cist & shaft tombs ^b | 15 | 680 | 590–770 | 790 | 680–920 |
| | Collective structures | 20 | 670 | 580–740 | 1330 | 1230–1450 |
| 5.2 | Patio group residential ^c | 70 | 780 | 760–830 | 910 | 890–930 |
| 5.3 | Monumental Compound | 24 | 690 | 570–770 | 1050 | 970–1160 |
| 5.4 | D-Shaped Structures | 20 | 720 | 640–770 | 1020 | 990–1070 |
| 5.5 | Roads and Waystations | 23 | 800 | 710–870 | 1000 | 910–1040 |
| 5.6 | Khipus | 5 | 810 | 590–960 | 950 | 770–1170 |

^a There are too few dates for the boundaries to be meaningful; table shows the modeled medians of the earliest and latest dates.

^b Two dates in this group have low agreement index (<60%) but we retain them.

^c One date in this group has a low agreement index (<60%) but we retain it.

assemblages. There is thus little evidence of interaction with Wari agents in these sites, either through direct procurement or through the influence of Wari ideas or lifeways. We categorize a site in the most specific category the criteria allow, with state installations being the most specific category and local sites the least specific.

3. Materials and methods

We began by surveying the literature and reaching out to colleagues across the Andes where research incorporating Wari settlements has been reported. Based on this data, we defined the six regions in which we have sufficient published radiocarbon data of Wari or Wari-affiliated sites to proceed. A minimum of 20 radiocarbon dates with Wari or Wari-affiliated contexts was the threshold we established for our regional inclusion criteria. While this is a very limited number of dates to characterize Wari regional chronology, it allowed us to consider six regions, with only one north of Ayacucho meeting this criterion. Our next step was to compile 417 relevant dates from these regions, including unpublished dates, from Middle Horizon contexts. Each of these was evaluated for associations with Wari material culture, local Middle Horizon material culture, and the material hallmarks of Wari institutions (Table 1). We removed from the regional databases 47 dates, mostly because of unclear associations with Middle Horizon material culture, and they remain in our log for reference (Supplementary Material). Other reasons for excluding dates included error ranges that were too large, inadequate contextual information, or dates that were incongruent with Middle Horizon context.

We recalibrated all dates with a mixture of the current calibration curves from the Southern and Northern hemisphere calibration curves, SHCal and IntCal (Hogg et al., 2020; Reimer et al., 2020). Since the precise mixture remained undefined in many regions, and is different in the different regions discussed here, we let the mix vary freely from 0 to 100% of both curves (Marsh et al., 2018). This improves accuracy, since it is unclear which curve or mixture to apply, while resulting in a minor reduction in precision of a few decades or less. At the scale of this paper's research questions, this is not an important difference, but for future research, we recommend recalibrating with regions-specific curve mixtures (see Marsh et al., this issue).

We incorporated the dates into Bayesian models in OxCal 4.4 (Bronk Ramsey, 2009). In a few cases, we modeled stratigraphic superpositions and combined dates from the same context or sample when this context information was readily available (Supplementary Material). Generally, we used single-phase models with uniform boundaries in order to incorporate the full range of 14C dates within each category. Uniform phase models are the most commonly used in Bayesian modeling since they have few assumptions: that the dates are related to each other, that is, they are not independent observations, and that they are evenly distributed in time (see Marsh et al., this issue). These are reasonable assumptions that researchers rely on to produce results that are “not importantly wrong” (Bayliss et al., 2007) because these models “almost certainly give us a more realistic interpretation” than using no model at all (Bronk Ramsey, 1998, p. 462).

We ran models for groups of dates, first grouped by region and then grouped by tradition/institution. The most important results are the starting and ending phase boundaries (Table 1) since these estimates are based on the aggregate probability distortions of all the dates in the model, which lets us see patterns not apparent from looking at individual dates. Subjective readings of date charts or lists give too much weight to individual early and late dates, often leading to unrealistically long spans. Instead, we look at the boundaries, which are probability ranges for the likely beginning and end each set of dates and the associated material culture. We summarize dates with Kernel Density Estimates, one for each type of site in each region. For Wari traditions or institutions, we have created a single KDE model across the sampled regions, though for mortuary traditions, they are separated by type. (KDEs; Bronk Ramsey, 2017). All models have acceptable agreement

indices ($A > 60\%$), meaning the dates' probability ranges and the model assumptions are internally consistent (Bronk Ramsey, 2009, p. 356). We use the following reporting conventions (Bayliss et al., 2007): modeled results are in italics and medians of probability distributions are indicated with a tilde (~), followed by the 95% probability range.

4. Results: dating wari impacts, region by region

We begin by examining six regions argued to have been colonized by Wari or affiliated with Wari material culture (Fig. 1). These include Ancash in the North, the Ayacucho heartland, Nasca to the West, Cusco to the southeast, Majes and the Arequipa valleys, and Moquegua in the far south. These six regions meet the criteria of having multiple Wari state or Wari affiliated sites and a corpus of at least 20 dated Wari contexts. We considered other potential regions, but did not identify a sufficient quantity of Wari dated sites for places like Cajamarca or Huarmey to be included in our analysis. Future research should permit investigators in these regions to undertake these analyses, however. We consider dates associated with Wari imported or affiliated ceramics, architecture, and other material culture and examine the start and end dates for Wari presence in the region, be it indirect or direct.

4.1. Ancash and the north

Northern Peru presents a complex data set for understanding Wari chronology. Our survey of published Middle Horizon literature for Cajamarca, Huamachuco, and Chachapoyas did not reveal radiocarbon dates associated with Wari material culture. Additionally, there are not enough published Wari-affiliated radiocarbon dates from the North Coast (Lambayeque, Jequetepeque, the Ancash coast). In those regions, Middle Horizon absolute dates are affiliated with Moche lifeways and limited Wari goods or Wari-Moche hybrid objects (see Castillo Butters, 2012 for a discussion). Meanwhile, excavations at Castillo de Huarmey have revealed a clear Wari enclave consisting of a palatial and funerary complex with abundant Wari-style material culture (e.g., ceramics, textiles, metals, and wooden objects; see Giersz, 2017). Unfortunately, Castillo de Huarmey's absolute dates have yet to be published. For these reasons, we focus our discussion of Wari chronology in the north on the Ancash highlands.

Our analysis of Ancash materials includes a set of 21 dates from sites with evidence of Wari material culture alongside local Recuay materials, from Honcopampa, Chinchawas, Queyash Alto, Ancash Punta, Llac Ama Caca, and Yarcok (Fig. 2). We define these sites as Wari affiliated. None of them had clear evidence of Wari state installation features, so that is not a category we can assess in highland Ancash. We also include a separate dataset of 32 Middle Horizon dates from sites without evidence of a relationship to Wari that appear to be geographically separated from the Wari affiliated zone. Local Ancash settlements without signs of Wari affiliation, largely concentrated east of the Cordillera Blanca, lasted from at least 600 CE to ca. 1050 CE (Fig. 3). The phase of Wari affiliated sites in western Ancash dates from ca. 630 CE and ends ca. 1000 CE, except for a single late date (Fig. 4). Thus, Wari affiliation was long-lasting in Ancash despite the lack of a Wari state installation, though perhaps Castillo de Huarmey on the coast may prove to be such a settlement once dates are published.

Our understanding of Wari chronology in highland Ancash is not straightforward, however. This is because many of the material correlates archaeologists usually associate with Wari imperialism—such as changes in settlement patterns, state infrastructure (e.g., roads, way-stations)—appear to have been absent there during the Middle Horizon (Lau, 2012, 2016). Despite the material absence of statecraft in the region, Ancash communities came to highly value Wari and other foreign material culture, particularly polychrome ceramics (e.g., Paredes Olvera, 2016). In the prior Early Intermediate Period, local leaders developed new political strategies aimed at garnering kin-based power and prestige. Independent Recuay groups established hilltop

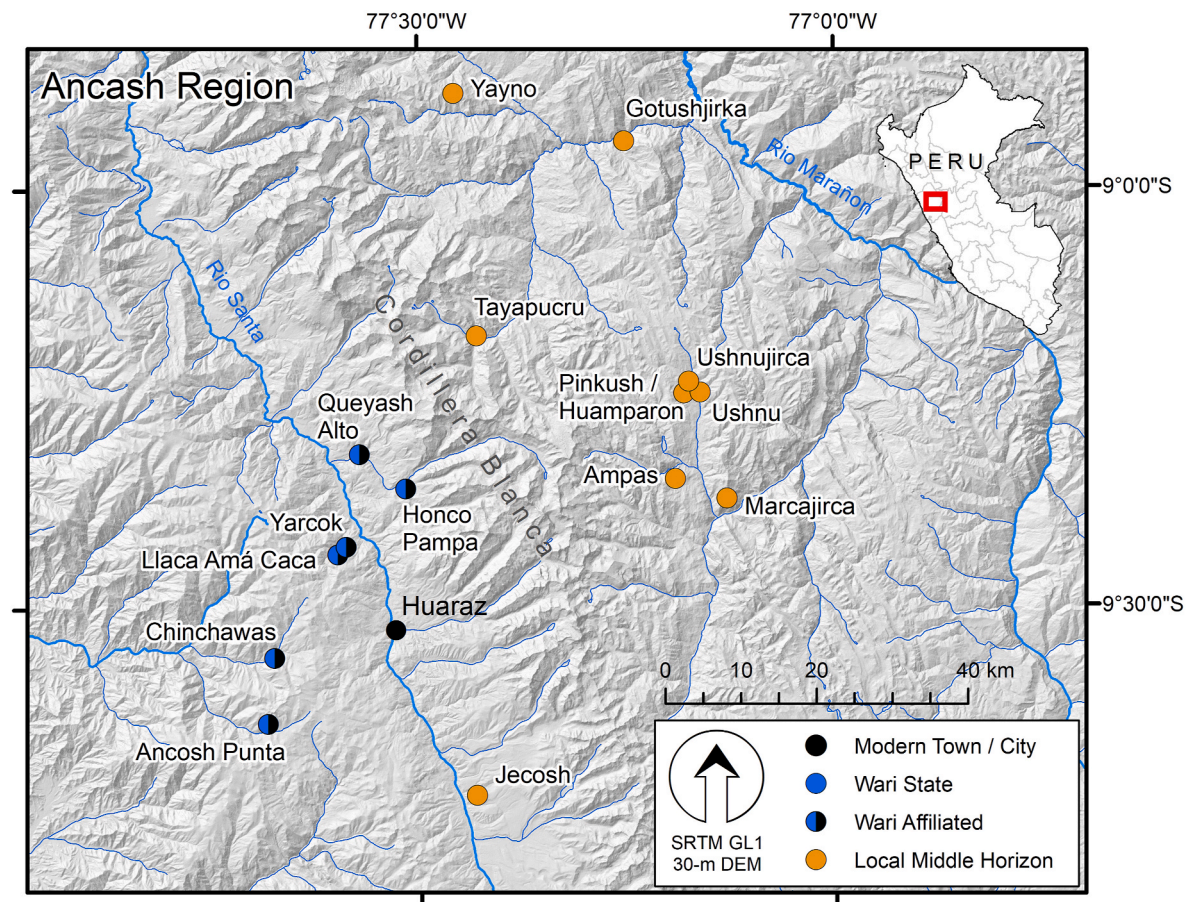


Fig. 2. Basemap of Middle Horizon sites in Ancash included in this study. Wari affiliated sites are clustered to the north and west of Huaraz, while local Middle Horizon sites are primarily east of the Santa River.

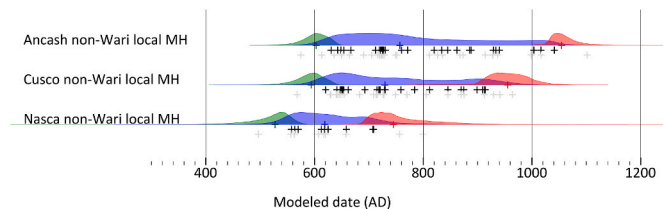


Fig. 3. Phase ranges for Non-Wari Local MH sites: Ancash (top), Cusco and Nasca (bottom). Non-Wari local sites are not present in the three other regions. The green bell curve represents the two-sigma phase starting date, while the red curve represents the likely phase ending date. The blue curve is the summation of the KDE model for all the dates used in the model.

settlements, wherein residential and ritual spaces served to legitimize lineage-based descent and intra-community social distinction (Lau, 2012). These contexts included feasting and ancestor veneration practices in residential and mortuary contexts (e.g. Briá, 2017; Gero, 1991; Grávalos and Sharp, 2022; Lau, 2002). By around 400 AD, Recuay communities had established trade relationships with Moche and Cajamarca groups (Lau, 2004). These economic relationships shifted at the onset of the Middle Horizon, with the incorporation of Wari-related ceramics, obsidian, and metal objects in funerary contexts. Recuay communities in the Callejón de Huaylas valley embraced Wari objects alongside other foreign valuables in a phenomenon that George Lau (2012) has referred to as “bundling”. Notably, Recuay communities in the parallel Callejón de Conchucos valley were not plugged into these expanding trade networks, as sites in the region lack foreign material culture despite continued village occupations into the Middle Horizon.

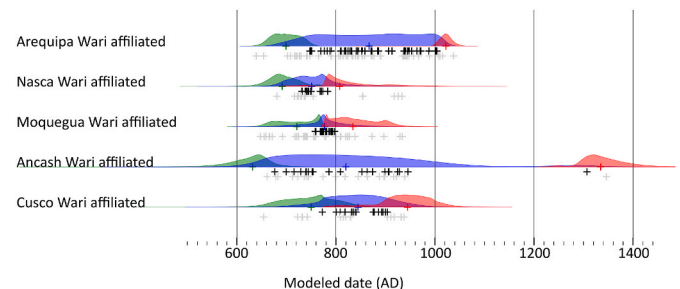


Fig. 4. Phase ranges for Wari affiliated sites from 5 of the six regions. Ayacucho is not represented since all dates come from sites categorized as state installations. The green cross is the likely starting date for the phase, while the red cross marks the likely end date. Individual dates in the model are represented by black and gray crosses.

Small villages in the Callejón de Huaylas, such as Chinchawas, began to experiment with new ceramic forms and colors, creating pottery that diverged drastically from the Recuay kaolinite style. Other communities at places like Hualcayán and Keushu also created new polychrome styles using locally available raw materials (Grávalos, 2021), drawing upon Wari polychrome designs and vessel forms—unfortunately, we lack radiocarbon dates for these contexts. Around the same time that people began to produce and utilize more Wari emulated ceramics and foreign goods in the Callejón de Huaylas, Ancashinos began to construct new mortuary monuments, shifting from subterranean mortuary chambers to above-ground chullpas. Monumental chullpas at Honcopampa and Wilkawaín near Huaraz in the Callejón de Huaylas were important loci

for commensalism, as were smaller chullpas at sites like Chinchawas, Jecosh, and Hualcayán (Bria, 2017; Grávalos and Sharp, 2022; Lau, 2001). William Isbell et al. (1991) have discussed the appearance of chullpas in the Middle Horizon, suggesting that their visibility on the landscape may have been a form of Recuay resistance to imposing Wari state actors entering the valley. While we doubt that Recuay communities were actively “resisting” Wari imperialists, chullpas were important symbols for ancestral land claims. Despite the appearance of chullpas during the Middle Horizon, these constructions were not imposed on local communities by outsiders; the wanka-pachilla masonry technique that characterized Early Intermediate Period subterranean tombs and houses was continued in chullpas. People often positioned chullpas near or on top of earlier subterranean galleries, and occasionally, Early Intermediate Period style monoliths and tenon heads adorned chullpas (Lau, 2016:215).

Orthogonal architecture and patio groups are hallmarks of Wari imperialists in other regions of Peru, but in highland Ancash, domestic patio groups were important features of many Recuay villages. This is perhaps why Schrieber (1992:100) proposed that Wari may have borrowed architectural styles from the Callejón de Huaylas. In highland Ancash, there are no radiocarbon dates for the construction of intrusive Middle Horizon patio groups; Recuay sites with patio groups were continually occupied from the Early Intermediate Period through the Middle Horizon. For example, the Recuay regional center of Yayno in the Callejón de Conchucos was occupied until at least 800 CE, and yet excavations there did not yield any foreign goods (Lau, 2010). Unfortunately, the elite patio groups revealed at Ichic Wilkawain (Paredes Olvera, 2016)—a clear Wari-affiliated site—lacks published radiocarbon dates. Even Honcopampa, previously argued to have been a Wari administrative center (Isbell, 1989), was more likely to have been an elite Recuay village that benefited from the heightened trade networks of the Middle Horizon. Architectural analysis revealed that Honcopampa shares little similarity in spatial layout, construction techniques, and stonemasonry to other Wari imperial sites (Tschauner, 2004). In addition, in the parallel Callejón de Conchucos, other Recuay sites such as Tayapucru, Huamparán, and Pinkush exhibit patio groups, but lack Wari goods (Ibarra Asencios, 2021; Orsini et al., 2011).

4.2. Ayacucho heartland

In the Ayacucho heartland, 25 dates come from Huari, Conchopata, Maraniyoq, Azangaro, and Qasa Pampa (Fig. 5). We have included the nearby administrative centers of Espíritu Pampa in Vilcabamba and Jincamocco in the Sondondo valley, both within 150 km of the heartland, for a total of 37 dates from Wari state installations in the heartland and adjacent areas (Fig. 1). At Jincamocco, we combined two dates from the lower occupation and modeled them as prior to the third date (Schrieber, 1992, p. 193). At Espíritu Pampa, six dates from Areas 1–2 were grouped as a phase (Fonseca Santa Cruz and Bauer, 2020). Each of these sites includes at least one hallmark of a state installation. We do

not have Wari affiliated nor local Middle Horizon sites in this dataset because 1) Excavations with radiocarbon dated contexts have focused on Wari state installations and 2) Being the heartland of Wari, all settlements will share some of the material culture of Wari affiliation.

We have opted to include the Sondondo Valley and Vilcabamba because these are important Wari state installations without a local regional context of dates for which they can be compared and because they are close enough to the Wari heartland to be part of a regular sphere of local interaction. The Wari state phase in Ayacucho begins ca. 700 CE in this dataset and endures until approximately 1090 CE. Comparatively, the state phase in Ayacucho begins around the same time as Cusco and Nasca and starts somewhat later than Moquegua. This discrepancy, where we expect Ayacucho would be the earliest origin of state installations, may be explained by the fact that the earliest evidence of Wari state installations in Ayacucho are deeply buried in some of the principal sites, and these contexts are less thoroughly investigated and rarely dated.

Unlike the other regions in the study, Wari monumentality is much more built up in the Ayacucho region, with recent excavations revealing Wari state context up to 10 m below the surface in some cases (Ochotoma et al., 2015). Many of the dates from the Wari heartland contexts, furthermore, reflect excavations of structures in the first two to 3 m of the surface. These are stratigraphically above many of the deeply buried contexts at the core of the Wari capital, for example, and thus reflect later manifestations of Wari state institutions in the heartland. Thus, these dated contexts do represent what might be considered mature Wari institutions and not the incipient development of Wari statehood.

The end of the state installation phase in the heartland is later than any other region, surpassing Cusco and Nasca by at least two generations and Moquegua by 3–4 generations. The later dates for the end of state installations in the heartland may be expected, as Wari loses its ability to project state power over long distances first, and its hegemony in the local region is the last to end. It is interesting in this vein that the farthest provinces, Moquegua and Arequipa, are the earliest to lose the state installations. Arequipa's very early end may reflect a sampling issue, but Moquegua seems to predate Cusco and Nasca by 1–2 generations in the end of the state installation phase.

4.3. Cusco

The Cusco region southeast of the Wari heartland has often been considered a key area of Wari colonization, mostly due to the large size of its state installation at Pikillaqta (Fig. 6). We consider 16 dates from this site, whose samples come from contexts associated with monumental architecture that strictly adheres to Wari state canons (Glowacki, 2005; McEwan, 1991, 1996). This includes large plazas, niched halls, and patio groups as well as smaller conjoined rooms. The Wari state phase in Cusco begins ca. 670 CE and ends around 1030 CE (Fig. 5). Along with Moquegua, Cusco has one of the longest phases of Wari state activity in our sample. The Wari state started to build and occupy its Cusco infrastructure very early in the Middle Horizon and ended its activities only a few decades before the end of the state installation phase in Ayacucho.

Wari affiliated sites in our Cusco sample include Chokepukio in the Lucre Basin, Hatun Cotuyoc in the Huro Valley, Muyu Roqo to the south (Paruro), and Raqchi to the southeast (close to Sicuani). All are characterized by Wari and Wari-related material culture such as pottery and obsidian laurel-leaf bifaces. Chokepukio is a large multi-component settlement with standing architecture close to Pikillaqta (McEwan et al., 2002). Its samples come from contexts associated with Wari and local ceramic styles. A few kilometers to the southeast, Hatun Cotuyoc is a residential settlement with no previous occupation. Its rectilinear walls depart from local architecture and its pottery assemblage is heavily focused on Wari styles, although many appear to be local copies. For these reasons, Hatun Cotuyoc is considered a Wari-affiliated site where Wari colonists lived (Skidmore, 2014). Further southeast, the site of

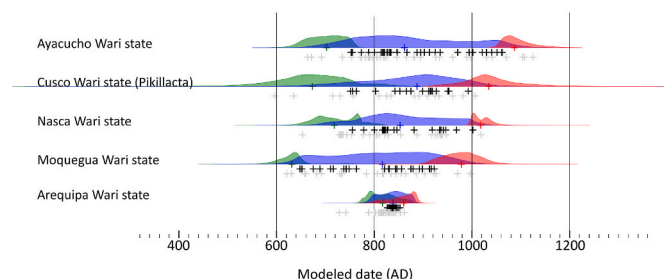


Fig. 5. Phase ranges for Wari State Installations from 5 of the six regions. Ancash had no dates in this category. Green crosses and curves represent the start of the phase, while red marks the end of the phase. Individual dates included in the model are represented by black and gray crosses.

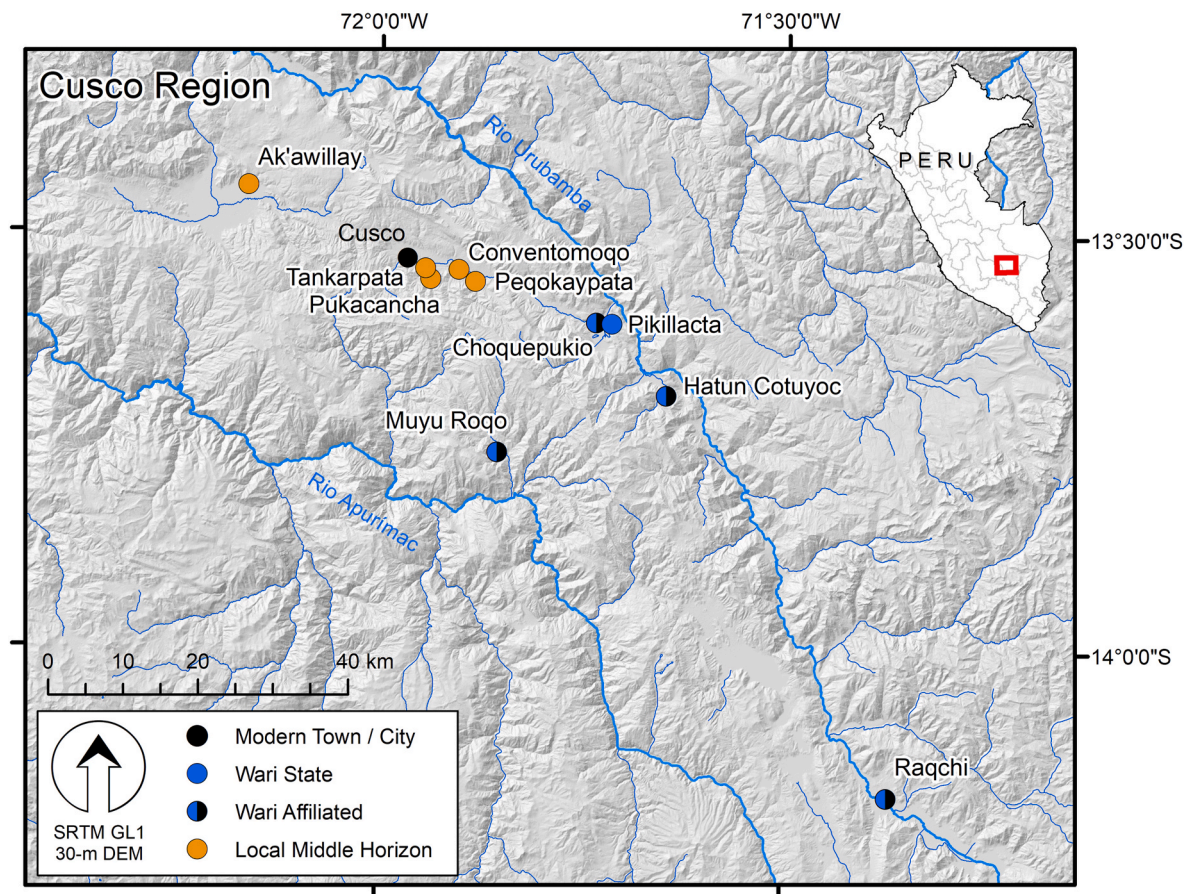


Fig. 6. Basemap of Middle Horizon sites in Cusco included in this study. The Wari state site of Pikillacta is closest proximally to the Wari affiliated sites in the study to the south. Local Middle Horizon sites are all north of Pikillacta in the Cusco valley proper or on the Plain of Anta.

Raqchi includes a series of circular conjoined structures within a walled rectangular enclosure. These structures, originally thought to be Inka store houses, have been reinterpreted as possible living quarters for Wari state workers (Sillar et al., 2019). Finally, the small site of Muyu Roqo to the south of the Cusco Basin contains a large amount of Wari and Wari-related pottery in addition to camelid bones. This settlement represents a locale of Wari feasting (Bauer and Jones, 2003).

The 17 dates from these Wari-affiliated sites in Cusco indicate a phase ranging from ca. 750 to 940 CE (Fig. 4). The starting date of this phase is later than that of the Wari state installation at Pikillacta. This somewhat contradicts the idea that Wari colonists settled in Cusco before large monumental architecture was constructed, however it is equally possible that a larger sample, especially from Wari state and Wari-affiliated sites in Huaró, could yield earlier results in the future. The end of this phase is later than Nasca and Moquegua but earlier than Arequipa. It is also earlier than the end of the Wari state phase in Cusco, which could reflect the abandonment of Wari-affiliated sites about three generations before the cessation of activities at Pikillacta. Towards the very end of the Middle Horizon, Wari influence in Cusco appears to have shrunk considerably and Wari activities were limited to Pikillacta.

A series of local Middle Horizon sites have also been excavated in the Cusco region, including Ak'awillay in the Xaquixaguana Plain and Peqokaypata, Pukacancha, Tankarpata, and Conventomoqo in the Cusco Basin (Bauer and Jones, 2003; Bélisle, 2015; Bélisle and Bauer, 2020; Bélisle and Quispe-Bustamante, 2017; Delgado González, 2016). All of these sites are characterized by local architecture and material culture, with occasional Wari fragments in overwhelmingly local assemblages. The Lucre Basin and Huaró Valley were the primary focus of Wari investment in the region, with little change in local settlement and limited Wari engagement beyond these areas. Among the local Middle Horizon

sites, regional data indicate that Ak'awillay was the largest center in the Cusco region at the time of Wari arrival (Bélisle and Covey, 2010). Furthermore, large-scale excavations at the site have identified various trade goods showing that its occupants were well connected to different parts of the Andes. Ak'awillay was first settled in the Late Formative (ca. 200 BCE) and some parts of the site were still occupied in the Late Intermediate Period and Late Horizon. The other four sites in our sample represent local settlements occupied before and during Wari presence in Cusco.

Twenty-five dates from these local Middle Horizon settlements indicate a Middle Horizon phase spanning ca. 590 to 960 CE (Fig. 3). The early start date of this phase stems from the fact that these sites were already occupied when the Wari arrived in Cusco. Wari material culture does not start to appear in the earliest contexts (i.e., 600 CE) but in those whose date ranges intersect with 670 CE, which is the start date of the Wari state installation phase in Cusco. The end of the local Middle Horizon phase is similar to the end of the Wari-affiliated phase in Cusco, both of which are earlier than the end of the Wari state phase in the area at 1030 CE. This suggests that Wari material culture was no longer procured locally after ca. 960 CE.

At Pikillacta, six dates are from a burned roof. We grouped these dates as a phase with a starting Tau boundary. This reflects the likelihood that most roofing materials would have been harvested shortly before the burn, mixed in with some older material (Bronk Ramsey, 2009; Marsh et al., this issue).

4.4. Nasca

Prior to Wari expansion into the Nasca Region (c. AD450–600) settlement pattern data indicate that Nasca society factionalized (Fig. 7).

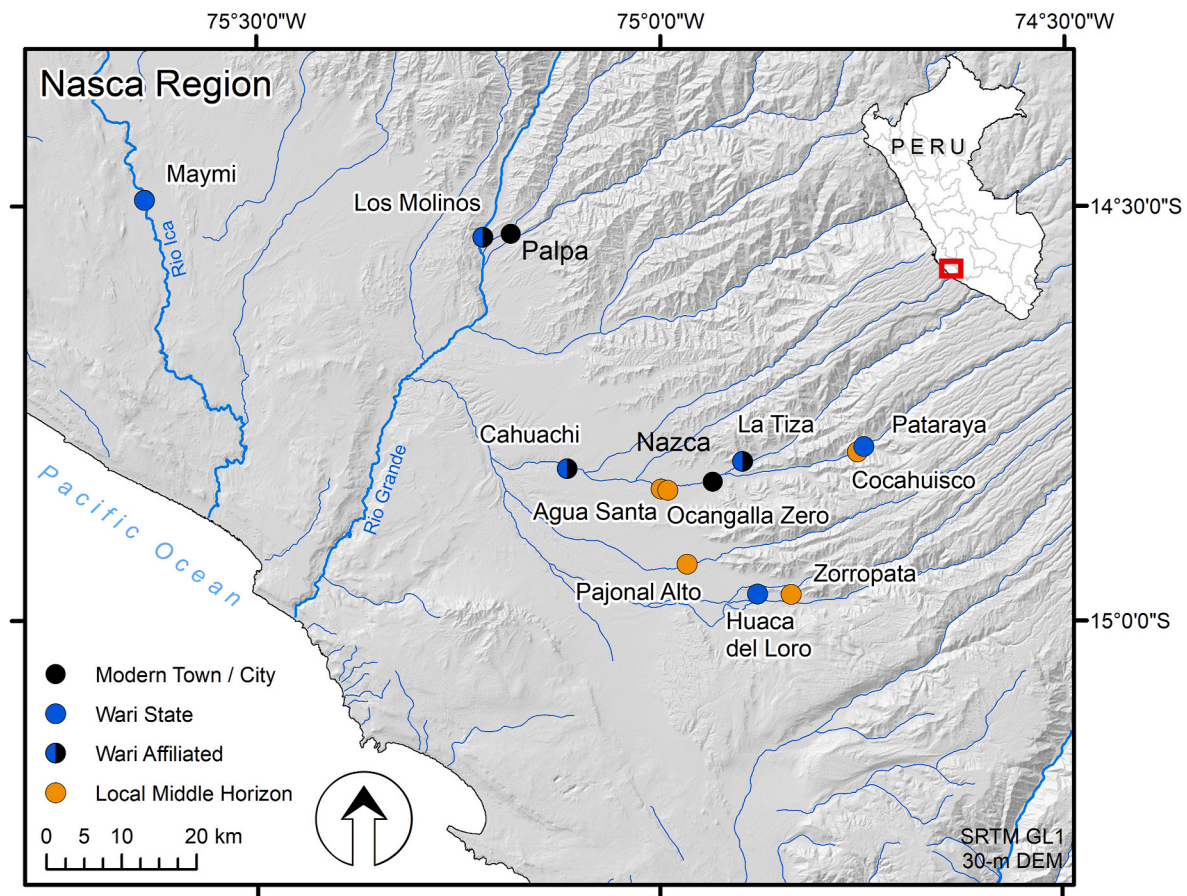


Fig. 7. Basemap of Middle Horizon sites in Nasca included in this study. Wari state installations are located in the southern valleys, while Wari affiliated sites are there and further north. Maymi did not contribute dates to this study, but is located for reference.

Populations aggregated into larger self-sufficient polities established in defensible locations with good visibility in different parts of the region (Isla Cuadrado and Reindel, 2005:63; Schreiber, 1998:263; Schreiber, 1999:167–168; Schreiber and Lancho, 2003:17). Late Nasca polities appear to have been in conflict with each other but still slightly integrated by Cahuachi, a prominent local Early and Middle Nasca ceremonial center (Kellner, 2002:80–81; Schreiber and Lancho Rojas, 2003:17). During this period, a relationship was shared between the Nasca culture and the Huarpa culture of the Ayacucho region, thought to be the cultural antecedent of the Wari Empire (Conlee, 2010:98; Knobloch, 1983:289–316; Leoni, 2010:67; Menzel, 1964:68; Silverman, 1989:27; Silverman and Proulx, 2002:93–94). This relationship is materialized in ceramic style and technology from both cultures dating to the late Early Intermediate Period. Nasca high-firing kilning techniques, slip-paint, and some stylistic elements and motifs in first Huarpa, then Wari pottery betray an exchange of ideas (Conlee, 2010:98; Menzel, 1964:5; Knobloch, 2005:117). Menzel thought that religion played a role in Wari expansion and was of particular importance in Nasca. Once the Wari Empire was established, Nasca had unique prestige among other groups that were incorporated into it (Menzel, 1964:68; see also, Knobloch, 1983). Nine radiocarbon dates from local Middle Horizon sites were incorporated. Our model of these local sites spanning this transition date the phase from 530 to 740 CE (Fig. 3).

Wari established at least three colonies in the Nasca region (Pacheco, Pataraya, and Inkawasi) during the Middle Horizon. They also established a state installation at Huaca del Loro (Conlee et al., 2021). Twenty-six radiocarbon dates from Pataraya and Huaca del Loro represent the Wari state installations in Nasca. Located in the Nasca Valley just below the confluence of the Tierras Blancas and Aja river valleys, Pacheco is thought to have had administrative and ceremonial

significance, however it was destroyed prior to 1952 (Edwards, 2010:469; Schreiber, 2005:247; Silverman, 1993:29). Julio Tello's field notes and maps of Pacheco prior to its destruction indicate that it was a substantial habitation site with architecture similar to Wari administrative centers in other regions (Conlee, 2010:96; Tello, 2002:9). William Duncan Strong sought the site in 1952 and locals informed him that it was destroyed during extensive clearing and irrigation work (Strong, 1957:43). Pataraya, located 35 km upstream from Pacheco in the Tierras Blancas Valley, served as a Wari outpost involved in the movement of local goods to the imperial metropole (Edwards, 2010; Kellner et al., 2013). Wari migrants were present at Pataraya (Kellner et al., 2013). Additional Wari-affiliated sites, including Inkawasi, Pacapacari, and Lambrasniyoq, are present in the zone upriver from the Nasca valley system leading to Ayacucho (Edwards and Schreiber, 2014; Isla Cuadrado and Reindel, 2014; Sossna, 2014). Two Wari sites are documented for northern Nasca valleys, Huayuncalla, and Tres Palos II. Pacapacari, and Lambrasniyoq have rectilinear compounds and D-shaped temples, characteristics consistent with Wari imperial canons and that link the sites to Wari. We await radiocarbon data for these settlements. Recent research at Huaca del Loro, the largest Middle Horizon site in the Nasca Region located in the Las Trancas Valley, documented rectilinear compounds and a D-shaped temple that link the site to the Wari heartland as a colony central to imperial control (Conlee et al., 2021). These sites are defined as Wari state installations in our models and span three centuries of occupation (720–1020 CE) based on the dates from Pataraya and Huaca del Loro (Fig. 5).

Wari influence may be evident in local Middle Horizon burial practices at La Tiza and Pajonal Alto. DNA evidence shows that Northern Nasca people moved into the highlands (Fehren-Schmitz et al., 2014), while non-locals lived at sites like La Tiza (Conlee et al., 2009). More

varied cranial modification styles during the Middle Horizon suggests an influx of migrants into the Las Trancas Valley (Kellner, 2002) and at La Tiza (Conlee et al., 2009). Immigrants are identified in the region during this period and intermarriage with foreigners was a practice possibly newly established. Prior to Wari, single burials predominated in the Nasca region and Early Intermediate Period Nasca burial practices were relatively conservative through time. In contrast, elaborate tombs with multiple burials, and evidence of reentry to tombs to place additional interments and grave goods were common in the Wari heartland (Isbell, 2001, 2004; Isbell and Cook, 2002). In the Middle Horizon, a new type of burial becomes more prevalent in the Nasca Region with tombs with multiple burials (Carmichael, 1995; Isla Cuadrado, 2001). These new practices are thought to be indicators of ancestor veneration or worship, which was focused on the deceased elites (Isbell and Cook, 2002:287–288). An elite identity may have developed in the Middle Horizon that was shared across a vast area that included Nasca, and Wari, and was reflected in the new burial practices. The non-local adult female buried in the new elite tomb type at La Tiza suggests that this new mortuary practice may have been brought in by foreign people who were associated with the Wari state. Thus, the changes evident at La Tiza may indicate direct Wari influence (Conlee, 2010:105). Strontium and oxygen isotopic analysis suggests there were actual foreigners living at La Tiza who were buried in the mausoleums during this period (Buzon et al., 2012; Conlee et al., 2009) and evidence of intermarriage with non local individuals of highland origins (Conlee, 2015). We classify 16 dates as Wari affiliated from the sites of Cahuachi, Huaca del Loro, La Tiza, and Los Molinos. The Wari-affiliated sites, several represented by mortuary contexts, date this phase from 690 to 810 CE (Fig. 4).

Concomitant with the Wari presence in Nasca, local settlement patterns indicate a shift in location. Early Intermediate Period Nasca settlements were most prevalent in the Nasca Valley, but during the Middle

Horizon, the population appears to shift away from the Nasca Valley to the southernmost valley, Las Trancas (Conlee et al., 2021; Conlee, 2010:97; Schreiber, 2005:248–249). New sites established in the Las Trancas Valley were in more defensible locations (Schreiber and Lancho, 2003:18). It is not clear what motivated the apparent relocation of Nasca peoples to the Las Trancas Valley, whether it was in avoidance of the Wari at sites like Pacheco and Pataraya, or if relocation was imposed by the Wari who established a colony at Huaca del Loro in Las Trancas (Conlee, 2010:98). This locational shift may explain the early end of the local Middle Horizon phase in the sample, ca. 740 CE.

The Nasca database is a complex one, with models suggesting early interactions of local folks with highland peoples. Wari affiliated settlements appear a few decades after the state installation phase begins, suggesting changes in material culture may have been precipitated by increased interaction with Wari agents in these places. Interestingly, both local and Wari affiliated phases end by 810 CE, while the Wari state phase continues until after 1000 CE. Where are the local people between 800 and 1000 CE? Are they all living in Wari state settlements by that time? There are a few post-800 CE Wari affiliated settlement dates in the model, which suggests at least for that category, additional sampling could refine the model.

4.5. Arequipa

The Arequipa region of southern Peru is geographically located between Ayacucho and the Wari's southernmost settlements in Moquegua. Wari colonists and agents of the state would have likely traveled through Arequipa during Wari's earliest expansionary stages. In recent years, archaeological investigations at Quilcapampa in the Sihuas Valley (Jennings et al., 2021) and Pakaytambo in the Chuquibamba-Majes drainage (Reid, 2023) have conclusively identified Wari colonists and

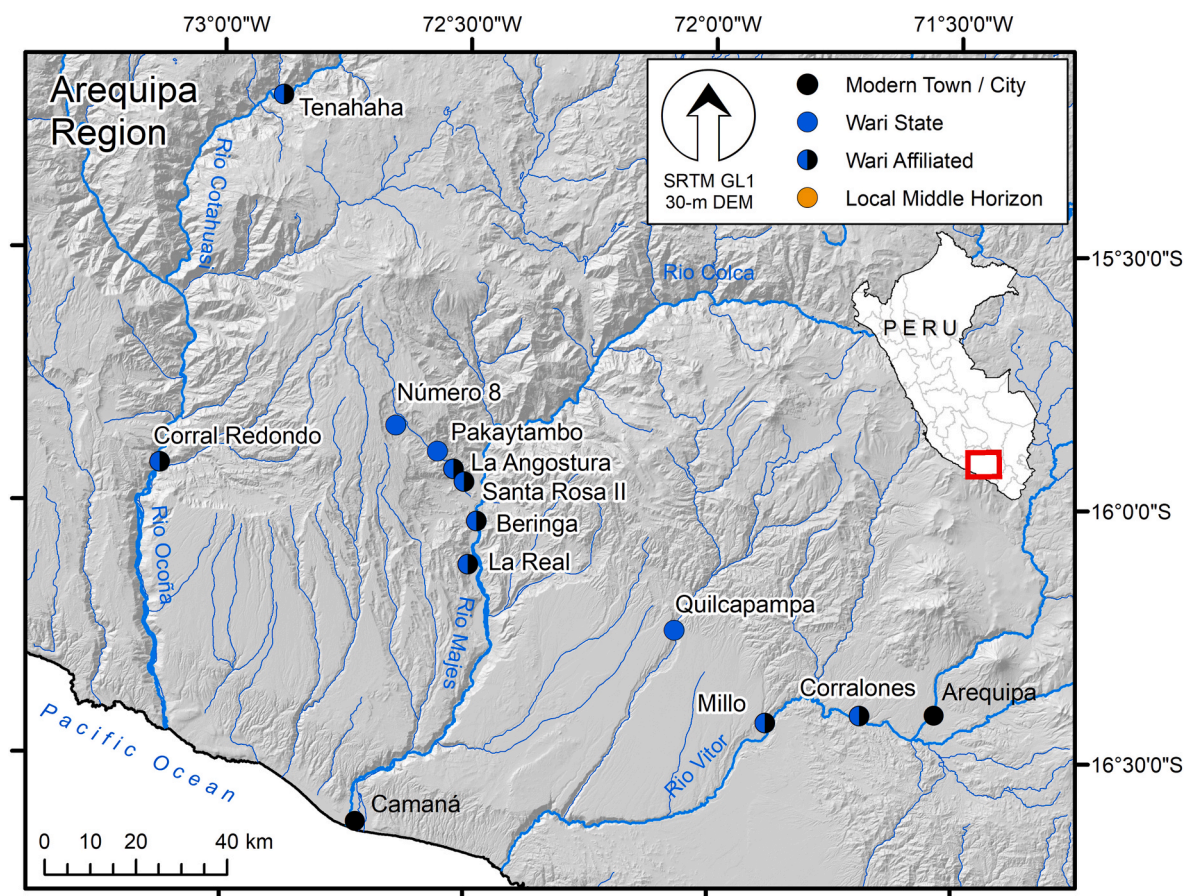


Fig. 8. Basemap of Middle Horizon sites in Arequipa included in this study. Wari state sites are located in the Upper Majes valley and in the Sihuas drainage.

state institutions along major highland-coast travel corridors that linked Arequipa's coastal valleys (Fig. 8). Based on a collective 36 radiocarbon dates, Wari state contexts in Arequipa started ~820 CE and likely only lasted one or two generations. The modeled dates show a Wari state presence in Arequipa well after initial Wari influence is observed at regional settlements (Fig. 5). At Quilcapampa, units 3, 17, 21, and 22 have two or three superimposed dates, which we modeled as short stratigraphic sequences, following Jennings et al. (2021a,b).

Our radiocarbon database for Wari-affiliated sites in Arequipa includes 54 dates from several sites, many of these re-published in Jennings et al. (2022), but also includes dates from the Chuquibamba-Majes drainage by Reid (2020, 2023). At Santa Rosa II, we modeled two phase 1 dates as prior to two phase 2 dates; and at La Angostura, we combined two dates from the same context. The modeled Wari affiliated phase in Arequipa begins ~700 CE with a terminal median date of ~1020 CE (Fig. 4). This terminal date is a century later than most other regions. If we only consider mortuary contexts in the Majes Valley, summarized later, the phase also has a very early starting boundary of ~650 CE.

The earliest evidence of Wari influence in Arequipa comes from the mid-Majes Valley. Excavations by Tung (2007) within habitation and funerary sectors at the village Beringa show an intense engagement with Ayacucho material culture including the adoption of Wari ceramic styles/forms and tie-dye textiles. Owen (2010) hypothesized that Beringa residents were related to Ayacucho settlers who brought predominantly Huamanga-style materials with them to Arequipa, however bioarcheological evidence remains lacking for this migration (Knudson and Tung, 2011). Nearby mortuary contexts from La Real also show an early Wari influence on local customs and burial goods. However, engagement with Wari materials and practices was uneven in the Majes Valley, with minimal Wari influence detected at Uraca, a multi-component Early Intermediate Period through early Middle Horizon site closer to the coast (Scaffidi and Tung, 2020).

By the late Middle Horizon, the first conclusive Wari migrants and state institutions were established in the Chuquibamba tributary of the Majes drainage, dating between 780 and 920 CE. At Pakaytambo, Wari imperial institutions correspond to the site's D-shaped temple enclosure, monumental platform construction, and flanking patio groups (Reid, 2023). Occupation may have overlapped with the Wari colony of Quilcapampa in the Sihuas Valley to the southeast, thought to be a brief occupation between 835–900 CE (Jennings et al., 2021:191–192). The excavators of Quilcapampa note material similarities to Wari in Nasca and it remains unclear how integrated these migrants were to state activities in Ayacucho or those at Pakaytambo, only a valley to the west.

Contemporaneous with Wari intrusion during the second half of the Middle Horizon, Arequipa witnessed a florescence of new settlements and Wari-affiliated sites that engaged with Ayacucho material culture, practices, and Wari peoples along major road and trail networks. These include the sites Tenahaha in the Cotahuasi Valley (Jennings and Yépez Álvarez, 2015); La Angostura, Santa Rosa II, and Huario in the Majes Valley (García Márquez and Bustamente Montoro, 1990; Reid, 2020); and Millo (Nigra et al., 2017) and Corralones (Cardona Rosas, 2002) in the Vitor Valley. The site Corralones is of special note, as its excavators have likened the architectural layout of patio-groups as a Wari way-station however constructed using local methods (Cardona Rosas, 2002). Two radiocarbon dates from the site also point toward a possibly early occupation ranging between 685–885 CE and 682–958 CE (calibrated, SHCal20).

The modeled Wari-affiliated terminal phase in Arequipa lasts until ~1020 CE well after the abandonment of Pakaytambo and Quilcapampa over a century earlier. Even after this terminal phase, local settlements continued to engage with Wari material culture and practices, such as at the late occupations of Número 8, Huamantambo, and Qosqospa in Chuquibamba (Goldstein, 2010). Several dates from these sites were omitted from the model as further investigations are required to understand the continued legacy of the Wari state in the region. Orthogonal site layout and patio-group architecture also proliferated at this

time extending into the Late Horizon in the lower Majes-Camaná Valley (Owen, 2010). Sites such as Sonay (Malpass, 2001) exhibit much later dates than the original excavators expected and residents may have drawn influence from the last vestiges of the Wari state in southern Peru.

Like other regions, Wari influence in Arequipa was intense and preceded any direct state presence or colonization efforts by Wari migrants. When the intrusive centers of Pakaytambo and Quilcapampa were established by the 9–10th century CE, they would have encountered local communities already engaged with familiar Wari “international” practices. This influence lasted well beyond the abandonment of Wari state centers in southern Peru.

4.6. Moquegua

The Moquegua region represents one of the most prolific sets of Wari and Wari related colonizations in the study corpus. It is a region farthest from the Ayacucho capital yet retains a strong evidence of Wari presence from its earliest expansion out of the heartland with a persistence to the end of Wari hegemony in the Andes. The site of Cerro Baúl, including the Pampa del Arrastrado sector, is the only site that qualifies as a Wari state installation in our analysis, given that it has three D-shaped temples, monumental architectural compounds, and residential architecture that strictly follows Wari canons (Fig. 9). Twenty-six C14 dates come from these contexts (Williams, 2001; Williams, 2020; Williams and Nash, 2006). The phase of Wari state installations occupation and use in Moquegua dates from ca. 630 CE to 980 CE (Fig. 5). It has one of the longest durations outside the heartland.

Wari affiliated sites include Cerros Mejia and Trapiche, as well as Wari affiliated contexts at Yaway Alta (Nash, 2022; Williams, 2020; Costion, 2013). Cerro Mejia is a hilltop settlement that like Cerro Baúl is intrusive and does not have pre-Wari settlement; it represents a plurality of the C14 dates in the model with 34 assays. We consider all these sites to be Wari affiliated, though some have closer ties to Wari colonization than others. Trapiche and Yaway Alta are the closest sites to local Middle Horizon settlements, but they both have significant connections to Wari, including a Wari style brewery at Trapiche and significant presence of Wari materials at Yaway (Costion, 2013; Green and Goldstein, 2010). Cerro Mejia appears to have been settled by colonists from adjacent areas impacted by Wari expansion, and Nash has argued that the Arequipa valleys may have been one source for its colonists (Nash, 2012).

The Wari affiliated sites have a phase range that starts at ca. 720 CE and lasts to 880 CE (Fig. 4). This starting date is several generations later than the state installation range for the region. We expected an earlier date given that a foothold would have to be established in the sparsely populated upper valley prior to the construction of major infrastructure on the summit of the large massif of Cerro Baúl (Nash, 2022). That is not apparent in the model, and it is a rather robust dataset with a good sample size across a number of sites. Future research may reveal other sites in the upper valley where this foothold was established. The end of this phase, a few generations before the end of the state installation phase, may reflect the replacement of upper valley settlers with Tiwanaku related villagers in the later phases of the Middle Horizon (Williams, 2020).

There are dozens of dates from Tiwanaku sites in the valley that are contemporary, if not slightly later than the Wari occupations (Goldstein, 2005). There are few examples of diagnostic Wari material culture in most of these settlements, though they are certainly not local either. Some Tiwanaku settlements are integrated into the Wari colonial sphere (Williams, 2013; Williams and Nash, 2016) but maintain a distinct Tiwanaku identity even in the face of Wari neighbors. We have argued elsewhere the interaction between Wari and Tiwanaku may have been substantial, but one was never subsumed into the other's political system. Co-existence with maintenance of identity boundaries was the norm for several centuries on the Wari-Tiwanaku frontier. Interaction was largely focused on religious institutions, demographic expansion, and perhaps through elite intermarriage (Nash, 2015). The dating of

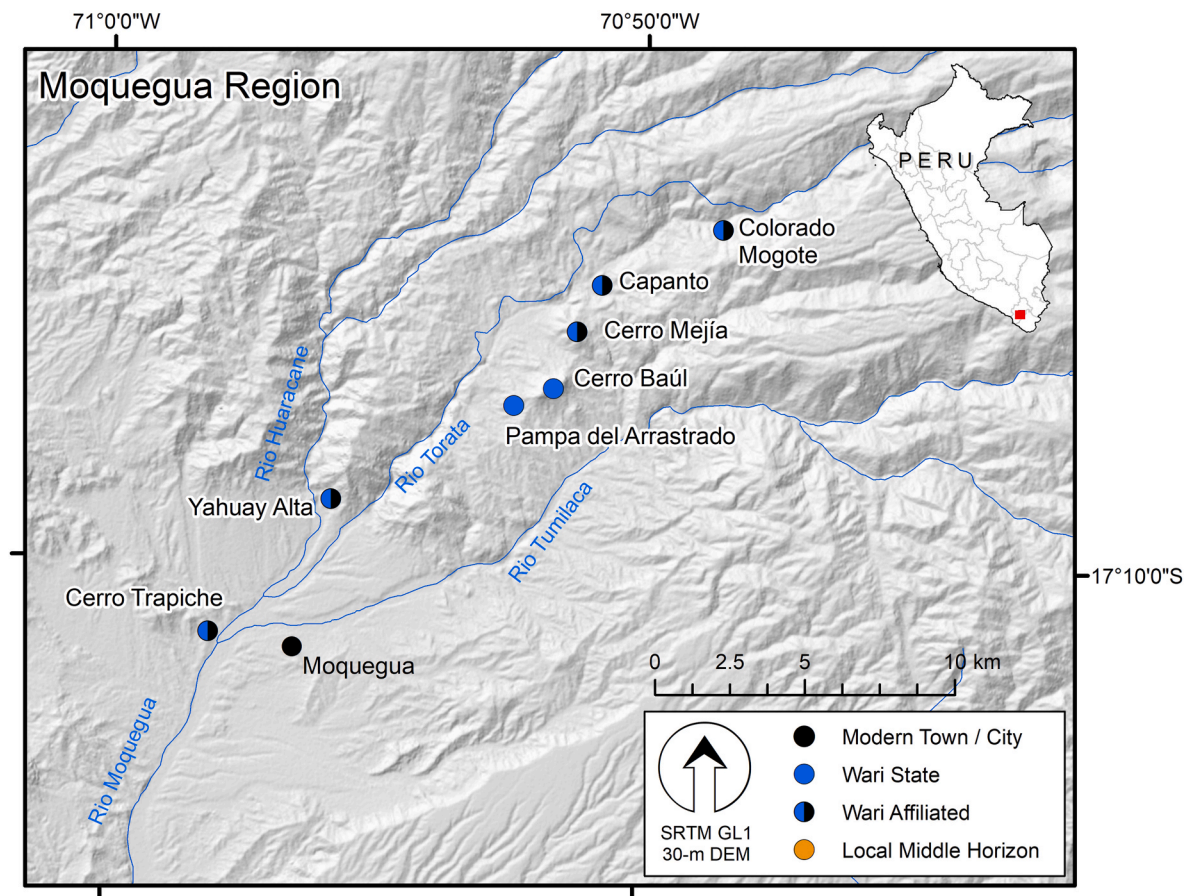


Fig. 9. Basemap of Middle Horizon sites in Moquegua included in this study. Cerro Baúl and the Pampa del Arrastrado site are the Wari state installations, while other sites pictured are Wari affiliated. The extensive network of Tiwanaku sites are located around and to the south of the modern city of Moquegua on the east bank of the Moquegua River.

these settlements is addressed in another paper in this volume (Marsh, this issue).

There are no “local Middle Horizon” sites in Moquegua that are not Tiwanaku or are not Wari affiliated in the dataset. This may be due to a lack of dates, and research in general, on the Formative Huaracane affiliated sites in the valley. The two dated sites in this analysis with Huaracane affiliations also have Wari affiliated sectors of local inhabitants interacting substantially with Wari through material culture and cultural practice. The lack of non-Wari affiliated Middle Horizon sites may also have to do with the unique juxtaposition of Wari and Tiwanaku in the valley. Perhaps the presence of two competing peers forced most inhabitants to choose an affiliation, or at least encouraged them to. Only further research on the Huaracane phenomenon through additional excavations and dating of these sites will resolve this question.

Wari phases in Moquegua are earlier than those in Nasca and Cusco for the state installations, as well as earlier than Ayacucho; this likely represents a dearth of C14 dates for the early Ayacucho contexts that are deeply buried under later occupations. It is odd that the earliest Wari state installation phase comes from the southern-most Wari region and may represent something unique about Wari imperial colascence on the Tiwanaku frontier. Wari affiliated sites are congruent with the beginning of the Arequipa, Nasca, and Cusco affiliated phases. Meanwhile, the Wari affiliated phase ends earlier than in Cusco and Arequipa, perhaps reflecting the predominance of Tiwanaku affiliated settlements in the late stages of Wari occupations in the Moquegua valley.

5. Results: dating wari traditions and institutions

In our second set of analyses, we evaluate the appearance of certain Wari traditions or institutions across these regions or within them. The most generalized traditions of Wari affiliation include mortuary traditions with Wari material culture and residential patio groups of Wari style. More specific institutions include Middle Horizon Khipu, Monumental Plaza Compounds, Wari road settlements, and Wari D-Shaped structures. We examine the appearance and longevity of the generalized traditions that are introduced during the period of Wari expansion first. We then turn to the specific institutions of Wari statecraft to assess both their relative date of appearance across the study regions, and the duration of their presence as markers of the temporality of the expression of Wari statecraft across the regions. All regions in the study are represented in either the mortuary traditions category or the residential architectural tradition. All regions except Ancash are represented by data for the specific institutions of Wari statecraft we examine. This may be due to a lack of data from Ancash and northern Wari sites in general (certainly Viracochapampa in the Cajamarca region might qualify to house Wari specific institutions, but lacks sufficient radiocarbon data for inclusion). It may also reflect a lack of Wari institutional presence in some regions. We turn first to a consideration of the traditions that accompany Wari expansion in all regions of study.

5.1. Mortuary traditions

Mortuary traditions are considered when they do not have local antecedents and have Wari affiliated material culture. These include the four ashlar tombs from the Ayacucho region, seven cave burial dates

from Arequipa, 15 cist and shaft tombs from Ayacucho, Nasca, Cusco, and Arequipa, and 20 collective mortuary structure dates from Ancash, Arequipa, and Nasca (Fig. 10). The ashlar tombs from Ayacucho were all disturbed, so we cannot be sure of their original intact assemblages. They are also a small group of dates that cannot be meaningfully modeled as a phase. The medians of the earliest and latest dates suggest a range from 850 to 1100 CE, which places them in the latest of the mortuary traditions. They are some of the most labor intensive tombs and likely represent elite burials given their locations and are restricted to the Wari capital and nearby sites.

The Ancash chullpas are a long-lived tradition, beginning by at least 700 CE and enduring into the Late Intermediate Period. We note that sampling is an issue here, with very few published radiocarbon dates associated with chullpas, and they have thus been grouped with the collective tomb traditions in Nasca and Arequipa. In Ancash, chullpas reflect local construction traditions and are often located on top of earlier Recuay tombs. Many chullpas in the region contain Wari material culture, but we note that they are a local innovation rather than an imposed foreign tradition. There are also many chullpas that contain no Wari material culture, but have other foreign goods, such as Moche and Cajamarca ceramics. This complex material assemblage indicates that the communities that built the chullpas were engaged with Wari agents and material culture, but that this relationship was one of many economic ties that local peoples maintained during the Middle Horizon.

The cave burial, rectilinear tomb structure, and cist tombs in the Majes valley, Arequipa Region, with Wari related material begins after 600 CE and other contexts of these mortuary patterns last into the Late Intermediate Period. Here we focus on those secure Middle Horizon dated contexts. The cave at La Real, dated by seven C14 samples, is earlier than the tomb structures there and the phase of use of this mortuary tradition lasts from 680 to 790 CE (Fig. 10). The dates from the cist tombs at Beringa (six samples) overlap with the cave, cist (3 samples), and collective burial (3 samples) types at La Real. We note these mortuary traditions are significantly earlier than many of the dates for settlements and other Wari institutions in the Arequipa region. Perhaps early Arequipa was akin to Ancash in some ways in that Wari institutions do not appear prevalently, but affiliated mortuary traditions and material culture do show up at an early date. That is not true of later Arequipa, where other institutions flourish.

If we consider mortuary traditions across the four regions where they are present, the cist & shaft tomb traditions dates ca. 680 CE through 790 CE (Fig. 10). These are primarily individual interments, in many cases with elaborate accompanying grave goods. The collective tomb structures, which include the chullpas of Ancash, mortuary buildings in Arequipa, and collective tombs in Nasca also date from 670 to 1330 CE. It is clear the mortuary traditions, both Wari cist tombs and collective mortuary structures, are introduced in regions where they did not exist previously fairly early in the Middle Horizon, coincident with the appearance of Wari state installations in many of these regions. While cist tombs were present in Nasca prior to the Middle Horizon, they are introduced elsewhere, especially the deep shaft tombs in Cusco and Ayacucho. In Ancash, Nasca, and Arequipa, collective or above ground tombs are a novelty for the period, though they appear in different forms in each region. In both cases, the traditions continue after the Wari and into the Late Intermediate Period.

People developed new mortuary traditions, then, as early as 680 CE and lasting well past the traditionally defined end of the Middle Horizon. In most cases, new mortuary assemblages and building traditions are the earliest evidence of interactions with Wari to emerge. In some cases, they are the only evidence of Wari influence. These new mortuary traditions coincide with the introduction of Wari state installations in several regions and are novel in others. Mortuary traditions are persistent and long-lived, and their appearance as new forms in so many regions in the Middle Horizon represents fundamental shifts in peoples' identities and conceptions of death and renewal.

5.2. Residential architectural traditions

Patio group residential architecture that does not have local antecedents and has affiliated Wari material culture is represented by 12 dates at Cerro Baúl, 12 from Conchopata, 17 from Pataraya and Huaca del Loro (Nasca), and 29 from Quilcapampa, Arequipa region. This range of residential architecture has a long duration among the institutions we considered. It starts just after 780 CE and ends ca. 910 CE (Fig. 10). It is earlier at Cerro Baúl and later at other sites in Arequipa, suggesting that perhaps residential settlement by Wari groups may have taken hold further south first and filled in over the centuries further north.

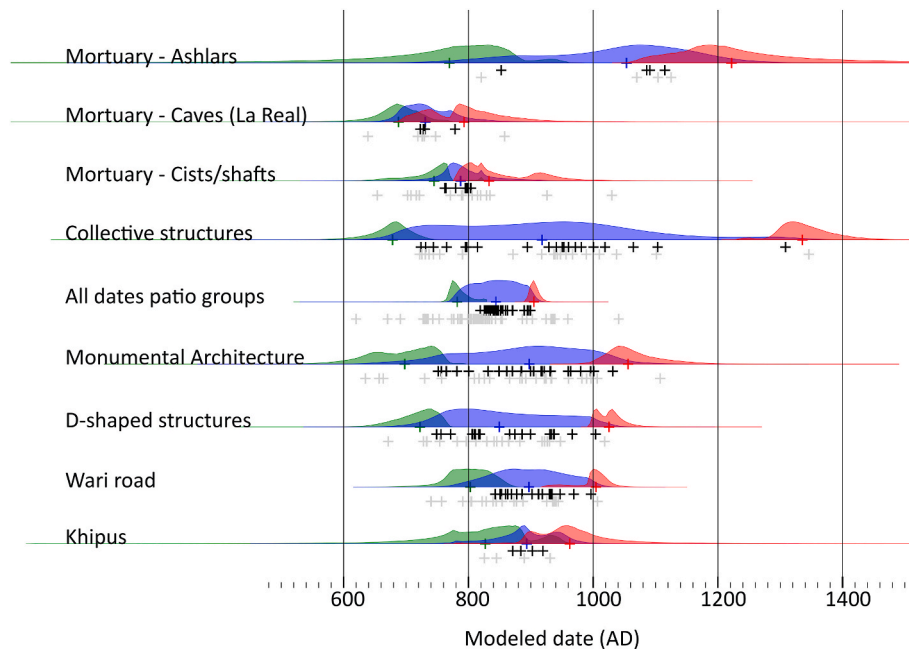


Fig. 10. Phase ranges for Middle Horizon Traditions and Wari Institutions. Green curves and crosses represent the phase start dates, while red curve and crosses represent the phase end dates. Blue curves are the KDE models for the dates incorporated in the model (represented by black crosses).

The large number of dated contexts from sites like Quilcapampa and those in the Nasca region, which have a much narrower range of dates than those from Conchopata in the Wari heartland and Moquegua on the southern frontier. The modeled phase of patio group architecture traditions starts at 780 CE and ends around 910 CE. This is much shorter than the full range of dates which discounts places with longer traditions as outliers. An explosion of this residential architecture tradition in the central two centuries of the Middle Horizon is significant and demonstrates that the patio group tradition was most active during the core periods of Wari expansion. We argue, however, that we cannot discount the early and late dates the model tends to ignore as the model is dominated by the large number of dates from the Nasca and Arequipa sites.

Residential architectural traditions, like the mortuary traditions mentioned above, tend to precede other markers of Wari institutional presence and show that lifeways preceded the introduction of state institutions with manifest material markers in many regions. The full range of the patio group dates range from 600 to 1000 CE, with a period of intensive activity in Arequipa and Nasca from 780 to 910 CE. All these dated contexts are from the heartland and the south coast, and that may also bias the sample of dates since we are missing dated examples from the North or from Cusco.

5.3. Monumental compound architecture

Monumental plaza compound architecture is represented at Cerro Baúl (Moquegua), Pikillacta (Cusco), Jincamocco (Ayacucho), and Azangaro (Ayacucho) by 24 dates. These are places with non-residential large-scale architecture, with plazas exceeding 1000 square meters and multistory buildings flanking them in regular patterns, including Nixed Halls at Pikillacta and Cerro Baúl. Wari material culture is also present. This phase of use of monumental buildings begins around 690 CE and lasts as late as 1050 CE (Fig. 10). Williams (2001) has argued previously that a reorganization of Wari centers to focus more on these monumental compounds took place around 750–800 CE and accompanied a shift in Wari's influence across many regions.

The phase of Monumental Compound Architecture, along with D-shaped structures, represents the earliest examples of Wari institutions of statecraft, clearly present by 700 CE. This may be a generation or two later than the earliest mortuary and residential architecture traditions. We might expect state institutions to appear somewhat later than the residential architecture of state elites and the mortuary traditions that accompanied the movements of people as it would take some time to colonize and establish footholds for the construction of state centers where these structures would have been built.

While Monumental Compound Architecture is inevitably found in state installations, the modeled phase of this architecture postdates the establishment of state installation sites. The establishment of Cerro Baúl, for example, starts ca. 620 CE, but it is several generations later that the Monumental Compound Architecture appears at the site. It is important to note that this architectural form, then, postdates the establishment of Wari state installations and represents an institutional development during the course of Wari statecraft, not one which was manifest in its origins. Once established, however, this architectural form persists as a part of Wari statecraft until the very end of the Wari phenomenon. It is the latest and last Wari institution to persist in the phase models of Wari institutions.

5.4. D-shaped structures

D-shaped structures include those from Cerro Baúl (Moquegua), Pakaytambo (Arequipa), Huaca del Loro (Nasca), Conchopata, and Espíritu Pampa (Ayacucho heartland). These too appear later in the Middle Horizon, with 20 dates of the phase of D-shaped structures starting around 720 CE and ending around 1020 CE (Fig. 10). The earliest D-shaped temple dates are distributed throughout the sample,

with Espíritu Pampa, Huaca del Loro, and Cerro Baúl all having a date prior to 1300 BP. D-shaped structures, along with Monumental Compound architecture, represent some of the earliest Wari institutions to appear. They also continue in use nearly as late as the monumental architecture phase, with the latest examples persisting at Huaca del Loro (1036 BP) and Cerro Baúl (1140 BP), far from the Ayacucho heartland.

It is interesting to note that dated Monumental Compound Architecture and D-shaped structures overlap at only one site in the sample: Cerro Baúl. This may be a sampling issue to some extent, but it is also true that D-shaped structures have not previously been identified in the Cusco region where Pikillacta is, nor in the Huamachuco region where the Monumental Compound site of Viracochapampa is located. We should note that purported D-shaped structures have been reported for the site of Honco Pampa in the Ancash region (Isbell, 1991), but because they were not excavated nor dated, we do not include them in our sample. Likewise, D-shaped structures in the Ayacucho heartland seem to overlap with Monumental Compound Architecture only at the Wari capital. Conchopata and Espíritu Pampa have patio group architecture and D-shaped structures, while Azangaro, Pikillacta, and Jincamocco have Monumental Compounds, but no D-shaped structures. Across the valley from Jincamocco, the site Llesqes Pata contains two D-shaped structures that align more closely with local places of power than state ongoing in the walled compounds of Jincamocco (Schreiber, 2004).

Do D-shaped structures and Monumental Compounds represent two distinct, but mutually exclusive institutions, with the exception at Cerro Baúl, where they both co-exist and are contemporary? Or perhaps the activities associated with D-shaped structures thrive outside the institutional imprint of the Monumental Compounds. In any case, it is clear that both emerge around the same time circa 100 years after the earliest evidence of Wari state installations and after the mortuary and residential architecture traditions propagate in Wari and Wari affiliated sites. These structures represent an institution of a maturing expansive state and have clear impacts and presence in several regions in the study. Other D-shaped structures reported beyond the study regions clearly indicate the institution had significant importance elsewhere in the Wari sphere (Reid, 2023).

5.5. Roads and waystations

The study of Wari roads is still in its infancy, but is reflected in the work of scholars primarily focused in the coast and highlands of regions south of Ayacucho (Edwards and Schreiber, 2014; Reid, 2020; Williams, 2017). Twenty-three road infrastructure dates come primarily from settlements in the Arequipa and Nasca regions, including Corralones, Santa Rosa II, La Angostura, and Pataraya, as well as Cerro Trapiche in the Moquegua Valley.

This phase of settlements along roads is rather late in the sequence, lasting from around 800 CE to just after 1000 CE (Fig. 10). The dating of roadside settlements requires an archaeological investigation of the road beds themselves to identify their proximity and relationship to sites and waystations. We attempted to restrict ourselves to dates that are parts of sites that have been clearly affiliated though landscape investigations with road fragments that connect settlements together and represent cohesive patterns of interregional transit between Wari regions. For example, the site of Pataraya lies in the upper reaches of the Nasca valleys and communicates between Ayacucho and Nasca (Edwards and Schreiber, 2014). Corralones and Cerro Trapiche are the connection points between road fragments that connect the Moquegua and Arequipa regions and count undated waystations between them (Williams, 2023; Williams, 2017).

Road infrastructure, then, is about associating the small settlements reliant on interregional road transit with the roads themselves. The dates from these settlements are likely dependent for their livelihoods on the transit along the road affiliated with Wari goods and information. Features of these roadside sites reflect their concerns with Wari affiliation (D-shaped structures at Pakaytambo and the Wari brewery at Cerro

Trapiche for example). We have only chosen sites that have been associated with road surveys with identified transit paths through previous publications. Thus, road dates could be amplified with further studies of transit landscapes in other regions that could expand this database substantially.

5.6. Institutional record keeping

The corpus of radiocarbon data for Wari record keeping is limited to 5 dates from Middle Horizon khipu from the AMNH (Urton, 2014). The phase of Wari khipu dates to between 810 CE and 950 CE (Fig. 10). This is a relatively limited set of data, but if confirmed by future samples, it implies that Wari record keeping was primarily dated to the Late Middle Horizon. These samples lack context, however, and are such a small number it is unlikely to represent the full population of Wari khipu use dates. The khipu AMNH 41.2/7678 was dated twice, so we combined the dates with R.Combine (Cherkinsky and Urton, 2014). We look forward to seeing dates from khipu from MH archaeological contexts, like those at Castillo de Huarmey (Giersz, 2017) or Huaca San Marcos (Shady Solis et al., 2000).

Given the small sample size, it is premature to intuit the longevity and introduction of this Wari institution from the dates represented by the model. The dates are internally consistent and do represent a fairly late and limited phase. It is fairly congruent with the other institutions of statecraft discussed above, especially with the dates of the Wari southern roads. In fact, the roads phase starts around the same time as the khipu phase and lasts 50 years later. That congruence might suggest that like the Inka system, movement of information coded in rope records between waystations along state road networks may have been critical to the functioning of the later Wari state. If that is correct, and the limited dates for road building and record keeping remain accurate, these institutions emerged nearly a century after those institutions marked by the specialized architecture of the monumental compounds and the D-shaped structures.

This hypothesis, that this type of information and transportation infrastructure was a late development in the imperial project, would be rather extraordinary, since these institutions are often presumed to be critical to the state expansion project. In fact, the Wari project may have been operational for 200 years without the formalization of the latest manifestation of the khipu recording system or the waystation and road networks. Clearly, further data and dates on these phenomena are needed to assess the preliminary data presented here.

6. Discussion

In the North, we note that the Ancash highlands have few direct dates for specific Wari institutions. Here economic influence in certain areas prevails and tends to reflect later Middle Horizon periods. Some areas of Ancash do not exhibit evidence of Wari affiliation, such as the Callejón de Conchucos (west of the Cordillera Blanca) and the southern Callejón de Huaylas (Lau, 2012). Many other Ancash sites not included in this study exhibit Wari material culture as well as local Middle Horizon ceramics with Wari-influenced design motifs, such as Hualcayán, Keushu, and Ichic Wilkawain (see Bria, 2017; Grávalos et al., 2023; Herrera Wassilowsky, 2005; Paredes Olvera, 2016), but unfortunately do not have associated dates at this time. We believe that radiometric dates from clear Wari-affiliated sites, such as Ichic Wilkawain in the highlands and Castillo de Huarmey on the coast are sorely needed to be better comprehend the nature of Wari relations in Ancash. Moreover, secure radiometric dates from other northern regions, such as Cajamarca, Huamachuco, and Chachapoyas would further our understanding of the complex political dynamics that took hold in northern Peru.

In the Ayacucho and Nasca regions, Wari state installations are emplaced early ca. 700–720 CE, slightly later than installations in Moquegua and Cusco. The regional anomaly in this group of Wari state installations is Arequipa, where the Wari state installations are modeled

to start a century later. We do note, however, that 32 of the dates for this phase come from the short-lived site of Quilcapampa, which may be over-representative of this single site that was likely occupied only 1–2 generations. The other four regions with Wari state installations are fairly similar in the initial dates for the establishment of state infrastructure. These data reflect the presumed origin of the state installation concept in Ayacucho, though it was rapidly deployed in other regions. What is also clear, as we might expect, is that state installations persist longest in Ayacucho, until 1090 CE. Nasca, Cusco, and Moquegua all have terminal dates between 980 and 1030 CE, which shows remarkable continuity in the end of state installations in the provinces. Certainly, these state installations were abandoned well before those in the Ayacucho heartland, indicating that the polity probably lost power in its most distant provinces first. Arequipa is again the anomaly here with the terminal end of state installations a century earlier at 860 CE, again likely due to the over-representation of data from Quilcapampa and perhaps the lack of identification of a principal Wari center in the region.

Wari affiliated settlements tend to appear in most regions between 630 and 700 CE. However, both Moquegua and Cuzco have a Wari-affiliated phase starting by 720–750 CE. We might expect Wari affiliation to predate the state installations, which does appear to be the case in Nasca and Arequipa. However, in Moquegua and Cusco the opposite is true, and three generations have passed by the time the Wari affiliated phase has started. We note that Cusco and Nasca have the fewest dates for these categories and this may reflect a sampling issue. One interesting factor is that Nasca Wari-affiliated settlements and local Middle Horizon settlements do not seem to persist past 800 CE despite the state installation phase lasting two hundred more years in the region. Was Nasca more effectively incorporated into the Wari heartland in the late Middle Horizon and thus independent settlements are absent during that time? Or is this a result of sampling and a lack of research on late Middle Horizon local settlements? It is also possible that depopulation of sites located further away from the Wari state installations in Nasca were responsible for the lack of late dated settlements in the region. Whatever the case, this is a topic that demands further investigation.

Terminal dates for other Wari-affiliated phases reflect a range of dates from 880 in Moquegua to 1020 CE in Arequipa. In Moquegua, we attribute this early end to the rise of Tiwanaku migrants around the Wari center of Cerro Baúl, replacing earlier Wari-affiliated settlers by and large in the peripheries of the Wari colony. It is several generations later that Wari-affiliated sites drop out of the Cusco and Ancash regions. In both Cusco and Moquegua, the Wari-affiliated sites disappear a century before the state installations, which likely speaks to an increasing diversity in material identity and cosmopolitan ideals in populations interfacing with Wari state institutions in later years. Interestingly, it is Arequipa and Ancash where Wari affiliation maintains the longest, perhaps a reflection of the persistence of mortuary traditions which make up a fair number of the dates there.

At some level, we do need to question how our criteria for differentiating between Wari-affiliated and local Middle Horizon sites are effective heuristic devices given this distinction between regions. In the Cusco region, the appearance of Wari and Wari-influenced items (e.g., ceramics) at local settlements postdates the construction and occupation of Wari state installations in the region. A few Tiwanaku-influenced items in the region are contemporaneous with Wari occupation, though these are not sourced directly to the Titicaca Basin as in Moquegua. Sites occupied before Wari presence do not show evidence for participation in Ayacucho-based networks. During the Middle Horizon, Wari traditions and material culture are concentrated at Wari settlements, with some Wari and Wari-affiliated items found at Cusco sites in local assemblages. Future research southeast of Huaró might provide stronger evidence for Wari engagement in that area.

The three regions where we have local Middle Horizon settlements outside of Wari's sway vary quite substantially in their duration. Ancash and Cuzco are most similar, with dates from 600 to 960/1050 CE. Our Nasca dates reflect an earlier transition to the Middle Horizon, though

interestingly are completely lacking in later Middle Horizon dates, which may reflect a more complete acculturation of Nasca and Wari society in the region. Here, we acknowledge the need for more research on local trajectories in the Moquegua and Arequipa regions, especially on the Huaracane and La Ramada cultural traditions who were settled in these areas prior to Wari arrival. Where we do have this data, it is clear that local traditions and cultural expressions were not extinguished by the Wari but thrived before and continued well after Wari disappeared from the equation. Certainly, Wari left its mark on many of these societies through increased trade and communication that lead to new social innovations within many of these groups. The other substantial contribution of Wari impact was in the mortuary and domestic traditions and the state institutions it innovated across the Andean regions.

The southern regions of Cusco, Arequipa, and Moquegua are areas in which the institutions of the Wari state are most manifest outside the heartland. They collectively represent each of the specific state institutions (with the exception of the *kipu*) and both mortuary and residential traditions. We note the state installations in Arequipa are significantly later and shorter in duration than in the adjacent regions of Moquegua and Cusco. This may reflect a lack of early investment in the region, or a failure to identify the principal Wari state installation due to preservation or other reasons. In Arequipa and Moquegua, the Wari institutions represented by D-shaped structures, Wari roads, and monumental compound architecture are all present. Cusco is represented in our database only by the specific institution of monumental compounds, but it certainly contained Wari roads that require further investigation and dating. It does not appear D-shaped structures were part of the corpus of Wari institutions in Cusco, which is interesting given that they are present in all other regions except possibly Ancash where the potential D-shaped structure at Honco Pampa has not been excavated.

Generalized Wari traditions across the six regions of the study appear to be in place early in the Wari expansion in the 7th and 8th centuries CE, including residential patio groups and mortuary traditions. Mortuary traditions are the first to appear, especially cave burials, cist and shaft tombs and collective mortuary structures all between 670 and 680 CE. Mortuary ashlar structures, a limited sample, seem to start somewhat later around 850 CE. Residential patio group architecture, meanwhile, has phase dates after 690 CE, suggesting elite burial tradition and the proliferation of elite residential architecture may have been more prolific during the period in which Wari state institutions flourished.

Evidence for specific institutions of statecraft including monumental plaza compounds, record keeping, road infrastructure, and D-shaped structures seem to manifest mostly in the 9th and 10th centuries, though we note that both monumental plaza compounds and D-shaped structures appear somewhat earlier, ca. 720–780 CE. While *kipu* and road phases start post 800 CE. New dates and data, of course, can alter these phase ranges and start and end times, but the present dataset does support this interesting dichotomy in which state institutions appear first. It is the architectural institutions (representing political and religious organs of the state perhaps) that predate the institutions of long-distance communication (*kipu* and roads). All Wari institutions and regional affiliations ceased by the late 11th century CE. The earliest appearing state institutions are also the longest lived, with D-shaped structures and Monumental Compounds in use until 1020–1050 CE. *Kipu* and roads seem to fall out of use by 1000 CE, at least based on the very limited number of samples for *kipu*.

We must also question how these institutions transform after Wari in new sites and places. There is clearly a link between Wari *kipus* and the Inca record keeping technologies, though we have not traced out that history yet. And we know the Inca utilized existing roads and paths as they crafted the Qhapaq Ñan centuries after the Wari transformed each region into its new rendition. Likewise, the Wari architectural traditions had an influence on Inca concepts of building and space. They had, of course, the ruins of Wari centers at Pikillacta and Huaro in their backyards. The afterlives of empire are the topics of another paper that takes

large scale approaches to macroregional chronologies.

7. Conclusions

We have presented a regional based Bayesian analysis of Wari presence across the Andes that has yielded some interesting insights into the dynamics of state institutions and interfaces with local settlements across the Wari empire. While we acknowledge our heuristic categories might have fuzzy boundaries that inhibit definitive answers to some questions, we also concur that the nature of imperial-local interactions are highly variable and require flexible approaches to categorization.

Our approach has reinforced earlier approaches to Wari chronology, with a consistent finding that Wari state installations thrived in many regions of the Andes from 670 to 1050 CE. We have also documented the persistence of local communities carrying on their own traditions in relative isolation to Wari materials, though maybe not to ideas, for those same durations. We have found significant variation in how settlements affiliated with Wari across space and through time. We documented and dated Wari affiliated settlements in all regions and noted that two of the study areas most closely aligned with Wari, Nasca and Moquegua, may have lost Wari affiliated settlements relatively earlier. We hypothesized this may have reflected further acculturation (Nasca) or further cosmopolitanization (Moquegua) of the communities with whom they were interacting.

In regard to Middle Horizon traditions and Wari institutions, our work has compiled chronological data over the six regions in a novel and insightful way and compared these institutions directly to each other. *Kipu* dates, D-shaped structures, road infrastructure, and monumental compounds have been discussed previously. Our work, however, takes a more inclusive multi-regional approach and an explicitly comparative chronological framework to assess how Wari institutions grew and changed over the years. We make explicit comparisons about which institutions accompanied the growth of Wari at certain stages and how that was manifested across space and through time. We identified potential correlations in chronological frames between institutions across the Wari domain to assess how imperial institutions emerged and grew. Our work demonstrates that state installations predated specific institutions in most cases (ca. 650 CE), and that early institutions like D-shaped structures and monumental compounds emerged early in Wari's growth (ca. 690–720 CE) and persisted for over three centuries. Other institutions appear to have emerged later as the empire matured, though we acknowledge limited data at present to confirm that.

We do agree that further contextual information that could enhance the Bayesian data would improve the integrity of the models; we only employed stratigraphic and other contextual information when we fully understood its implications, and the models could obviously be improved with further contextual data. Likewise, as the database of Wari and Middle Horizon dates grows, and new regions reach the threshold of comparative radiocarbon data, the picture of Wari expansion and integration may change in nuanced and radical ways. We do hope, though, that this explicitly comparative model can be a framework for building upon an understanding of the complexity of Wari and its Middle Horizon contemporaries across the Andes.

Data availability

Radiocarbon data is presented as supplementary data to this article, including unpublished C14 dates presented for the first time here.

CRediT authorship contribution statement

Patrick Ryan Williams: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **David A. Reid:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Data curation, Conceptualization.

M. Elizabeth Grávalos: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Erik Marsh:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis. **Véronique Bélisle:** Writing – review & editing, Writing – original draft, Investigation, Data curation. **Christina A. Conlee:** Writing – review & editing, Investigation, Data curation. **Sarah Kerchusky:** Writing – review & editing, Writing – original draft, Investigation, Data curation. **Gordon McEwan:** Writing – review & editing, Investigation, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.quaint.2024.04.007>.

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