CHAPTER 24

HIGHLAND FORAGERS OF THE CENTRAL ANDES

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Introduction

Between 12,800 and 3,500 years ago, forager societies inhabited high-altitude zones of the central Andes Mountains of South America. This is one of the world's most challenging environments for biological reproduction—a hypoxic landscape with polar and hyperarid zones of low bioproductivity. Not only did human forager populations solve the adaptive challenges of the high Andes, but they also flourished, becoming one of just a handful of world populations to develop Indigenous agro-pastoralism, which catalyzed urbanization and state formation among the Tiwanaku, Wari, and Inca cultures. Highland foragers of the central Andes are furthermore the distant ancestors of vibrant Aymara, Quechua, and other Indigenous communities who live in the highlands today. The history of highland foragers spans over 9,000 years, encompassing more than 75% of the region's human history. Thus, the study of highland foragers of the central Andes is a study of an extreme case of human adaptability, the origins of agro-pastoral economies, the evolution of socioeconomic complexity, the cultural foundations of Andean highland cultures, and the region's most persistent socioeconomy.

This review of highland forager economies outlines the sequence of cultural developments that emerged between the time of human arrival in South America approximately 13,000 years ago until the spread of highland agro-pastoral economies around 3,500 years ago. Despite the challenges of studying mobile populations that left few material traces thousands of years ago, nearly a century of archaeological research has generated remarkable insight into the lifeways of these early groups. A number of field-based research programs involving survey and excavation reveal broad behavioral patterns as well as geographic and temporal variability. In the past decade, biomolecular techniques have infused additional clarity and nuance.

After introducing the ecological context of the central Andean highlands, this chapter will outline behavioral developments organized by the following archaeological time periods: Paleo-Indian (14–12 cal ka), Early Archaic (12–9 cal ka), Middle to Late Archaic

(9–5 cal ka), and Terminal Archaic (5–3 cal ka) periods. This chronological scheme, and its archaeological characterization, corresponds closely to previous chronological schemes for the northern Altiplano (Aldenderfer 1998), southern Altiplano (Núñez and Santoro 1988), and Andes more generally (Lavallée 2000). All dates are presented in thousands of calendar years before present (cal ka) in order to accurately reflect the temporal precision of the data. Any radiocarbon-based dates have been calibrated using the 2020 southern hemisphere calibration curve (Hogg et al. 2020) as implemented using the Bchron package (Haslett and Parnell 2008) in the R statistical computing environment (R Core Team 2022). The review of each archaeological period will trace the evolution of diet, mobility, technology, and social organization with the aim of understanding the processes of high-altitude adaptation, the evolution of cultural complexity, and the foundations of Andean cultural traditions.

Ecology

The Andes Mountains are a north-south trending mountain chain spanning over 7,000 km, including the entire length of western South America from its intersection with Panama to Tierra del Fuego. Elevations range from sea level to 7 km, with the highest mountain peaks being Aconcagua, in Argentina, and Chimborazo, in Ecuador (Figure 24.1). The Andean highlands generally refer to regions above 2.5 km in altitude. This is the altitude above which lowland organisms commonly experience acute mountain sickness with symptoms of headaches, dizziness, nausea, and fatigue (Aldenderfer 1998; Beall 2014). The central Andean highlands extend from approximately 5° to 30° south latitude and cover an area of approximately 1 million km^2 (derived from Danielson and Gesch 2011). Although much of the Andean terrain is rugged, an expansive high-plain region known as the Altiplano lies at the center, flanked by the western and eastern cordilleras.

The high altitude also makes for an extremely cold environment, even at tropical latitudes. The Köppen-Geiger climatic classification scheme, which is based on seasonal air temperatures and precipitation, identifies the north-central high Andes as a polar tundra (Beck et al. 2018; see Figure 24.1). Annual temperature and precipitation regimes are generally unimodal, with daily highs of 20–25°C occurring in January and lows around 0°C in July. Annual precipitation can range from under 300 to over 1,000 mm. The highland climate varies along two major axes—an elevational gradient in which higher elevations impose cooler temperatures and an orographic effect that increases aridity from northeast to southwest (Winterhalder and Thomas 1978).

Although the topographic relief and latitudinal range create considerable environmental diversity, an expansive regional ecosystem known as the puna characterizes much of the high Andean environments (Osorio et al. 2017; Figure 24.2). The puna is dominated by grasses and shrubs. Only a single, small endemic tree genera known as *queñual* (*Polylepis* spp.) occurs on the puna (Winterhalder and Thomas 1978). The ecosystem is broadly divided into wet and dry puna, which generally correspond to the north- and south-central Andes, respectively. Perennial rivers and freshwater lakes are common in the wet puna, with the largest lake being Lake Titicaca in southern Peru and northern Bolivia. Saline lakes and salt flats are pervasive in the dry puna, with the largest being Salar de Uyuni in southern Bolivia.

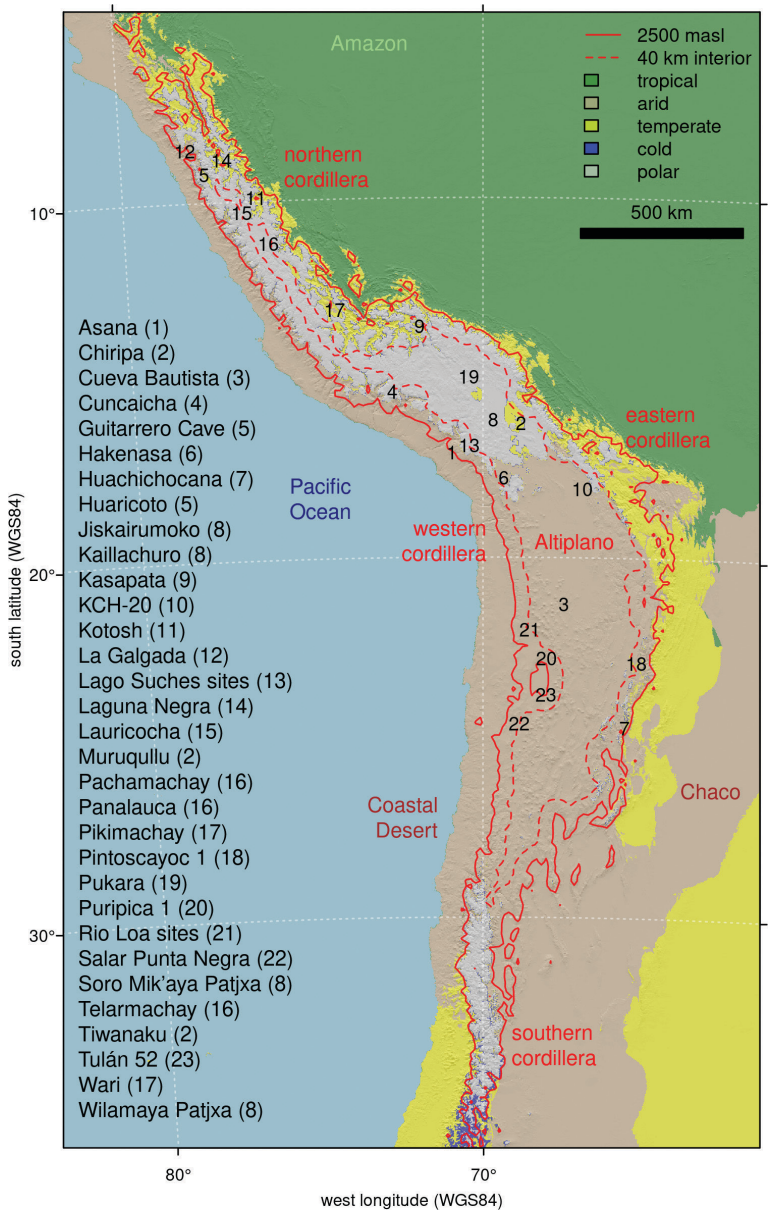

FIGURE 24.1 Geography of the central Andean highlands showing sites referenced in this review. (Credit: the author)

Economically important animal taxa include vicuña (*Vicugna vicugna*), guanaco (*Lama guanicoe*), taruca (*Hippocamelus antisensis*), montane *cuy* (*Cavia tschudii*), and carache fish (*Orestias* spp.). The zone is also favorable for animal husbandry (Wheeler 2012). Of relevance to Archaic forager populations are alpaca (*Vicugna pacos*), llamas (*Llama glama*), and *cuy* (*Cavia porcellus*). Some of the most economically important plant taxa include

FIGURE 24.2 The puna ecosystem of the central Andean highlands. This is a high-altitude grassland and mountain environment that supports large mammals such as vicuña (shown here) and Andean deer. (Credit: the author)

chenopods (*Chenopodium* spp.), cushion plant (*Azorella* spp.), ichu grass (*Jarava ichu*), maca (*Llepidium meyenii*), totora (*Schonoplectus californicus*), *queñual* (*Polylepis* spp.), and wild potatoes (*Solanum* spp.); of these, highland foragers domesticated chenopods, maca, and potatoes (Browman et al. 2018).

Modern ecological conditions of the central Andean highlands were largely in place at the beginning of the Holocene epoch, 11.7 cal ka, though the period between 8.0 and 5.5 cal ka was one of increased general aridity (Baker et al. 2001a; Rigsby et al. 2003) that resulted in the salinization and drying of many lakes (Núñez et al. 2002; de Souza et al. 2022). Conditions were markedly different during the preceding terminal Pleistocene epoch. The Younger Dryas period (12.9–11.7 cal ka) of the terminal Pleistocene was colder, wetter, and more variable than much of the Holocene epoch (Baker et al. 2001b, 2001a; Thompson et al. 2003). Despite extensive glaciation during the Younger Dryas, megafauna was present in the highlands. Excavations have revealed the presence of now-extinct taxa in deposits as late as 12 cal ka (Capriles et al. 2016a; MacNeish et al. 1983a; Villavicencio and Werdelin 2018). These include horse (*Hippidion* sp.), ground sloth (*Catonyx* spp., *Diabolotherium nordenskioldi*, and *Megatherium* spp.), gracile llama (*Lama gracilis*), and macroachenia (*Macroauchenia patachonica*).

Paleo-Indian Explorers, 12.8–11.7 cal ka

The first human populations expanded into South America from North America beginning around 13,000 years ago (Fiedel 2022). Archaeological evidence suggests that Native American exploration of the highlands commenced around that time or slightly later. Reviews of early sites in the central highlands observe the first clear evidence of human

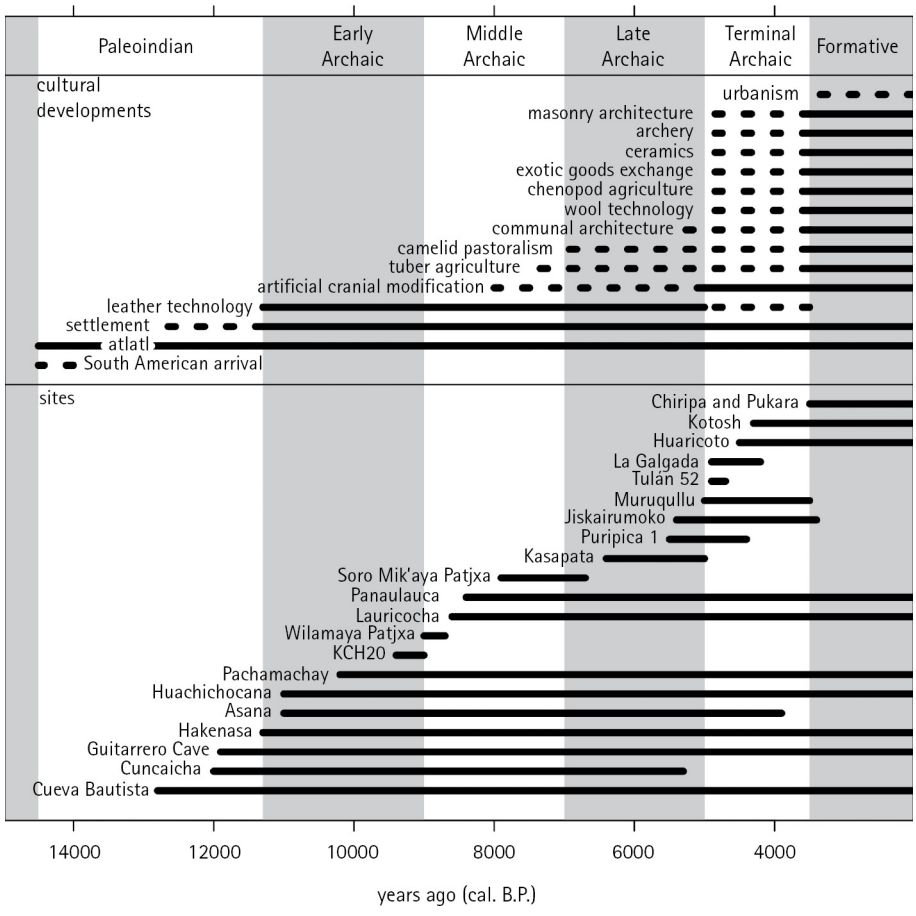

FIGURE 24.3 Sequence of archaeologically detected cultural developments among central Andean foragers with chronological placement of key sites. Solid lines indicate widespread presence of behavior, and dashed lines indicate incipient, equivocal, or waning presence. (Credit: the author)

activity around 12.7 cal ka (Aldenderfer 2021; Capriles and Albarracin-Jordan 2013; Capriles et al. 2016a; Lynch 1990; Núñez et al. 2001; Rademaker et al. 2014; de Souza et al. 2021; Yacobaccio 2017). A quantitative meta-analysis of culturally associated radiocarbon dates shows that the first reliable cultural signal occurs at approximately 12.8 cal ka (Gayo et al. 2015). The earliest directly dated cultural artifacts in the central highlands include a single piece of two-ply cordage and square-knotted leaves dating to 12.0 cal ka from Guitarrero Cave (Jolie et al. 2011). These data all converge to suggest human use of the highlands beginning around 12.8 cal ka (Figure 24.3).

Some of these earliest highland explorers were equipped with a fluted projectile point technology known as fishtail points (Figure 24.4a and b). Fishtail points were likely attached to long darts that would have been launched with a spear throwing technology known as an atlatl (Hughes 1998). Although projectile point fluting—the delicate removal of large flakes

FIGURE 24.4. Projectile points provide invaluable chronological and geographic indices of cultural variation among highland foragers of the central Andes. (a and b) Paleoindian fishtail points (Patané Aráoz and Nami 2014; Rademaker et al. 2014). (c–j) Early Archaic broad contracting stem and eared points (Capriles et al. 2018; Haas et al. 2020; Sandweiss and Rademaker 2011). (k–r) Middle and Late Archaic foliate, large stemmed, and large concave-base points (Craig 2011; Haas et al. 2015, 2020; Haas and Viviano Llave 2015; Klink and Aldenderfer 2005). (s–z) Terminal Archaic small stemmed and triangular points (Craig 2011; Klink and Aldenderfer 2005). (Credit: the author)

from the base of lanceolate projectile points—offers mechanical advantages in hunting megafauna (Eren et al. 2021), the technology was nonetheless culturally distinct, restricted to a limited period in the Americas between 13.1 and 11.3 cal ka (Fiedel 2022; Maggard 2015; Nami and Stanford 2016; Waters et al. 2015). Thus, the occurrence of fishtail fluted points indexes a cultural lineage within a broader fluted point tradition. Highland fishtail points may even suggest specific cultural descent from Clovis cultures of southeastern North America (Nami 2020). Genetic evidence furthermore suggests that the South American expansion of fluted points was part of a population expansion—as opposed to a cultural diffusion—associated with the ancestral A genetic lineage (Moreno-Mayar et al. 2018; Posth et al. 2018). The clear association between fluted point technology and Pleistocene megafauna exploitation in North America (Haynes 2022; Mackie and Haas 2021) coupled with the spatiotemporal co-occurrence of fishtail points and megafauna in South America suggest that megafauna hunting was part of the early highland economy and, further, that Paleo-Indian populations played a role in the extinction of some taxa (Prates and Perez 2021).

The archaeological record of Paleo-Indian activity remains diminishingly sparse despite decades of research including dozens of field investigations documenting thousands of early sites and projectile points (Aldenderfer 1998; Cipolla 2005; Craig 2011; Haas et al. 2015; Klink 2007, 2005; MacNeish et al. 1983b; Núñez 1980, 1981; Núñez et al. 2002; Núñez and Santoro 1988; Rick 1980, 1996; Santoro and Núñez 1987; de Souza 2004; Vining et al. 2018). Currently, only six fishtail points are known from five central highland localities, all from surface contexts, including one point from the eastern cordillera at Laguna Negra (León Canales et al. 2004), one from Tillane in the western cordillera (Díaz Rodríguez 2008), two from the Pucuncho site in the western cordillera (Rademaker et al. 2014), one from an unspecified locality in the Salta province of northwest Argentina (Patané Aráoz and Nami 2014), and one from the Punta Negra site in the western cordillera of Chile (Grosjean et al. 2005). Several other fishtail points have been reported in the highlands (MacNeish et al. 1983c; Núñez and Grosjean 1994) but are either unconfirmed or have been misidentified (Lynch 1990; de Souza 2004).

To date, only one interior site—Cueva Bautista in the south-central highlands—has produced directly dated cultural features from the Paleo-Indian period (Capriles et al. 2016a). Retouched flakes dominate that lithic assemblage, and reduction debris is sparse, suggesting logistical use of the site. This ephemeral use coupled with the site's interior location suggest an instance of seasonal occupation of the highlands (sensu Haas et al. 2017). All other occurrences of Paleo-Indian artifacts occur on the highland margins, consistent with logistical use by lowland populations. This rarity of Paleo-Indian sites particularly in the interior indicates limited Paleo-Indian use of the highlands. Further, consistent with this hypothesis, genetic evidence suggests that the split between highland and lowland populations did not occur until after the Paleo-Indian period, approximately 10.5–8.2 cal ka (Harris et al. 2018; Lindo et al. 2018).

Early Archaic Pioneers, 11.7–9.0 cal ka

Between 11.7 and 9.0 cal ka, human presence in the highlands intensified as indicated by the widespread distribution Early Archaic projectile point forms and numerous well-dated

sites extending into the interior. Early Archaic period cultural strata and features are well documented in sites of the western cordillera, including Asana (Aldenderfer 1998), Cuncaicha (Rademaker and Hodgins 2018; Rademaker et al. 2014), and Hakenasa (Osorio et al. 2011), and northern cordillera, including Guitarrero Cave (Jolie et al. 2011; Lynch 1980), Pachamachay (Rick 1980), Pikimachay (MacNeish et al. 1983b), and Telarmachay (Lavallée et al. 1995).

Early Archaic projectile point forms are distinct from the earlier fishtail forms, suggesting cultural discontinuity. Early Archaic points tend to be smaller and include contracting broad stemmed, eared, and triangular forms (Klink and Aldenderfer 2005; Rick 1996; Figure 24.4 c–j). These point forms bear greater similarity to contemporaneous late Paiján stemmed forms of the north-central Andean coast than fishtail points (cf. Haas et al. 2015; Maggard 2015), which suggests that Early Archaic highland populations may have descended from Paleo-Indian Paiján populations. Consistent with this hypothesis, genetic data reveal that sometime prior to 9 cal ka, a distinct biological population expanded out of North America into South America and largely replaced the ancestral A populations (Posth et al. 2018). It thus seems quite likely that the Early Archaic expansion into the highlands was a gene-culture expansion.

The Early Archaic period sequence at Asana suggests that highland occupation was initially seasonal but became permanent after 10.7 cal ka (Aldenderfer 1998). Consistent with this model of gradual adaptation, the current suite of Early Archaic dates from interior highland localities tend to be late, around 9 cal ka (Capriles et al. 2018; Haas et al. 2020). Stable oxygen, carbon, and strontium isotopes from human remains dating as early as 9 cal ka at Cuncaicha and Wilamaya Patjxa confirm permanent use of the highlands by at least that time (Chala-Aldana et al. 2017; Haas et al. 2020), which coincides with a genetic estimate for a lowland-highland split around 9 cal. ka (Lindo et al. 2018). Thus, the widespread occurrence of Early Archaic materials throughout the highlands coupled with temporal, geographic, isotopic, and genetic data converge to support a model of gradual establishment in the highlands between 11 and 9 cal ka.

The Early Archaic period is therefore the period when human genetics would have come under selection for high-altitude adaptation. As on the Tibetan Plateau, high-altitude adaptation entailed genetic selection for hypoxia response (Beall 2014; Brutsaert et al. 2019; Fehren-Schmitz and Georges 2016). In addition, genetic analysis identifies another adaptive pathway with selection at the DST locus, which is associated with cardiovascular health and differential expression under hypoxic conditions (Crawford et al. 2017; Fehren-Schmitz and Georges 2016; Lindo et al. 2018).

Among the cultural responses to life at high altitude, thermoregulatory technologies were essential in the adaptive process. Hide-processing tools, especially side and end scrapers, are pervasive in Early Archaic lithic assemblages (Aldenderfer 1998; Capriles et al. 2018, 2016a; Fernández Distel 1986; Haas et al. 2020; Lavallée et al. 1995; MacNeish et al. 1983c; Osorio et al. 2011; Rademaker et al. 2014; Rick 1980; Lynch 1980). Red ocher is commonly associated with Early Archaic scrapers (Haas et al. 2020; Julien et al. 1981; Karakostis et al. 2020; Lavallée et al. 1995) and may have been used for hide-tanning as an antimicrobial and waterproofing agent (Brandt and Weedman Arthur 2002; Rifkin 2011). Bone awls are also common in rock shelter assemblages and likely contributed to leather craft (Lavallée et al. 1995; Lynch 1980; MacNeish et al. 1983c; Núñez and Santoro 1988).

Housing was another critical thermoregulatory technology of the Early Archaic period. Pole-framed huts, which may have been covered with hides or grass thatching, were

constructed with central fire hearths as evident in the Early Archaic deposits at Asana (Aldenderfer 1998). A twined totora (*Schoenoplectus californicus*) textile fragment from Guitarrero Cave, with a direct date of 11.1 cal ka, may have served as a ground pad (Jolie et al. 2011) to minimize heat loss by ground conduction as is common in the high Andes today (Banack et al. 2004). Insulation and heating technologies were clearly central to the adaptive success of Early Archaic highland forager populations.

A broad-spectrum diet also appears to have played a role in the adaptive success of Early Archaic foragers of the central highlands. The ubiquity of projectile points and ungulate bone at Early Archaic sites indicates that hunting played a prominent role in Early Archaic economies. Camelid and taruca bones tend to dominate early faunal assemblages (Aldenderfer 1998; Noe et al. 2025; Rick and Moore 2012). Despite such evidence for hunting, the bone isotope chemistry of Early Archaic individuals from Wilamaya Patjxa show that plant foods comprised approximately 80% of the diet (Chen et al. 2024; Haas et al. 2020)

Early Archaic social organization was rather egalitarian, as might be expected among forager societies. The few human burials that are known from this period contain few or no grave goods (Francken et al. 2018; Haas et al. 2020). The "richest" Early Archaic burial is a young adult female who was interred with a large-mammal hunting and processing toolkit containing 22 lithic artifacts, including projectile points, scrapers, choppers, flakes, red ocher, and burnishing tools (Haas et al. 2020). Evidently, the individual acquired a modicum of status that allowed her to take her toolkit to the grave, unlike any of her known contemporaries. These observations not only highlight a degree of equity in Early Archaic highland communities but also suggest a degree of female prestige and nongendered labor practice.

Why Early Archaic populations established permanent residence in the highlands while Paleo-Indian populations did not requires explanation. Both push and pull dynamics may have been at work. The ancestral populations of South America would have shed many cold-adapted cultural traditions as they expanded through the tropical ecosystems of Mesoamerica and northern South America (Garvey 2021). Lacking such traditions, the costs of highland exploitation were likely too high and opportunities of lowland pursuits too great to justify permanent occupation of the highlands (Aldenderfer 1998; Capriles et al. 2016b; Loyola et al. 2019). With the extinction of many megafauna taxa, a new economic niche emerged for broad-spectrum foraging—one that Paiján-descendant populations of the north coast may have been better positioned to exploit. Over several hundred years, Early Archaic populations developed thermoregulatory technologies—especially leather clothing and heated housing—that permitted year-round habitation of the highlands and access to the interior regions.

Middle to Late Archaic Boom and Bust, 9.0–5.0 cal ka

With forager populations firmly established in the highlands during the Early Archaic period, populations experienced major demographic shifts during the Middle to Late Archaic periods. Whereas more northerly populations of the wet puna environments grew (Cipolla 2005; Craig 2011; Gayo et al. 2015; Klink 2005; Vining et al. 2018), more southerly populations

of the dry puna virtually disappeared from the most arid regions—a phenomenon termed the *silencio arqueológico* (archaeological silence) (Núñez et al. 2013, 1999). These shifts correspond to a well-documented period of extreme aridity between 8 and 5 cal ka (Baker et al. 2001a; de Souza et al. 2021). During that time, Middle to Late Archaic populations appear to have taken refuge in wetter regions that were more resistant to the climatic downturns (Grosjean et al. 2007; Núñez et al. 2013; de Souza 2004; Vining et al. 2018). By the Late Archaic period (7–5 cal ka) in the Titicaca basin, Archaic population levels peaked (Craig 2011; Klink 2005; La Favre 2011; Vining et al. 2018), creating unprecedented socioeconomic tensions and opportunities.

Large mammal hunting continued to play an important role in the economy as evidenced by the ubiquity of projectile points and large-mammal bone in Middle to Late Archaic assemblages (Aldenderfer 1998; Craig 2011; Kitchel et al. 2022; Klink 2005; Noe et al. 2025; Rick 1980; Rick and Moore 2012). The importance of animal hides continued, as evident in the ubiquity of scrapers and in the prominent muscle attachments of the hand phalanges of a Middle Archaic individual dating to 8.5 cal ka at the Cuncaicha shelter (Karakostis et al. 2020). Late Archaic populations not only hunted large mammals, but they also appear to have begun managing them. A series of faunal assemblages in the north and south central Andes show distinct increases in camelid to cervid ratios and neonate representation as well as thick dung deposits, all suggestive of penning practices (Aldenderfer 1989; Kuznar 1989; Lavallée et al. 1995; Moore 2016; Noe et al. 2025; Rick and Moore 2012).

As in the previous Early Archaic period, plant foods continued to play an important role in Middle to Late Archaic diets. Stable isotope bone chemistry of Middle and Late Archaic individuals from the sites of Soro Mik'aya Patjxa and Wilamaya Patjxa near Puno and Kasapata, near Cusco, produced values consistent with plant-dominant diets (Chen et al. 2024; Turner et al. 2018). Middle and Late Archaic individuals at Soro Mik'aya Patjxa furthermore show dental wear patterns that are indicative of intensive tuber processing (Watson and Haas 2017). Genetic adaptations for starch digestion are estimated to appear in the highlands around 8 cal ka (Jorgensen et al. 2022; Lindo et al. 2018). Plant food remains are abundant and diverse in Guitarrero Cave strata dating to 11.3–8.4 cal ka, further suggesting the importance of plant foods during the Middle Archaic period (Smith 1980).

With population growth in the northern highlands came increasing cultural differentiation. During the Middle and Late Archaic periods, a series of distinct projectile point types emerged, including bipoint, foliate, shouldered, large stemmed, and large concave-base forms (Figure 23.4k–r). Regional variation is, furthermore, evident among those forms. Large stemmed forms are distinct between the northern and western Lake Titicaca basin (Cipolla 2005). Large concave-base forms vary between the wet and dry puna regions, where lanceolate and shouldered versions occur, respectively (cf. Klink and Aldenderfer 2005; de Souza 2004). Similarly, Late Archaic rock art traditions in northern Chile exhibit variation in design elements that correspond to increasingly differentiated economies and cultural norms (Sepúlveda et al. 2019).

This period of population growth, diet expansion, and cultural differentiation appears to have emerged in a competitive social climate. Evidence of interpersonal violence is observed at Soro Mik'aya Patjxa, where at least 2 of 16 individuals experienced some form of perimortem interpersonal violence (Haas and Viviano Llave 2015)—a rate that is comparable to those observed during other violent times in the Andes (Arkush and Tung 2013). One of the Soro Mik'aya Patjxa individuals is an adult male with dental evidence of intensive

tuber processing and a perimortem projectile point impalement (Haas and Viviano Llave 2015), highlighting the potential connection between diet breadth expansion and competition. An increase in projectile point size during this time frame is, furthermore, consistent with hypotheses of heightened aggression and limited resources (Chen et al. 2022).

While violence offered one release for social tensions, communities also explored new norms of cooperative interaction. At Asana, public architecture first appeared around 8 cal ka, evident as ovoid prepared clay floors averaging 14 m^2 (Aldenderfer 1998). These structures appear to have served as a communal space for small, presumably cross-kin groups, engaged in nondomestic activities. It was also around that time that some central Andean foragers initiated the iconic practice of artificial cranial modification evident as early as 8 cal ka at Soro Mik'aya Patjxa, where everyone in the community received the modification treatment during infancy (Haas and Viviano Llave 2015). This behavior is also observed at the site of Kasapata, 6 cal ka, in the Cuzco region (Bauer 2007). Whatever the proximate motivations for this body modification practice, the trait unavoidably served as a highly visible, honest signal of cultural affiliation. The appearance of communal architecture and cranial modification clearly indicate that nonkin groups of the central Andes began organizing in new ways via integrative cultural norms during a period of high population density and high rates of interpersonal violence.

Terminal Archaic Transformation, 5.0–3.5 cal ka

Around 5,000 years ago, highland populations of the central Andes declined (Craig 2011; Gayo et al. 2015; Klink 2005; La Favre 2011; Vining et al. 2018), suggesting that any efforts to solve the Late Archaic climate and demographic challenges were unsuccessful in the short term. The proximate cause of this decline, whether disease, diaspora, depressed fecundity, or violence, is unknown, but the ultimate cause likely relates to population-resource stress and environmental degradation. Deforestation is evident in paleoecological reconstructions, suggesting lost access to critical fuel sources (Craig et al. 2010). Rates of interpersonal violence in the Terminal Archaic period appear to have continued at similar levels to the Late Archaic period as evident among 2 of 14 individuals at Muruqullu (Juengst et al. 2016). The Terminal Archaic was likely a turbulent time.

Nonetheless, the Terminal Archaic was also a period of major transformation with a surge in technological and cultural developments (see Figure 24.3 Error: Reference source not found). Plant and animal domestication took hold and began to replace foraging as the economic mainstay. The earliest unequivocal domesticate in the highlands is the common bean (*Phaseolus vulgaris*), directly dated to 5 cal ka at Guitarrero Cave (Kaplan and Lynch 1999). Domesticated aji chili pepper (*Capsicum baccatum*) has been identified in the same strata at Guitarrreo Cave (Smith 1980) and in the hearths at La Galgada (Grieder and Bueno Mendoza 1985), suggesting its early domestication. Increases in the ubiquity and size of maca (*Lepidium meyenii*) tubers and chenopod (*Chenopodium* spp.) seeds beginning around 4 cal ka at the north-central Andean site of Panalauca signal nascent domestication of those taxa during the Terminal Archaic period (Pearsall 1989). Early thin-testa chenopod seeds from

the Titicaca basin further indicate Terminal Archaic domestication (Bruno 2006). Starch grain analysis of ground-stone artifacts from the site of Jiskairumoko provide evidence of potato domestication by 4 cal ka (Rumold and Aldenderfer 2016). Modern potato genetics and geography identify the central Andean highlands as the center of potato domestication (Hijmans and Spooner 2001; Spooner et al. 2007; see also Jorgensen et al. 2022). These numerous independent observations in different parts of the northern highlands make clear that plant domestication largely transpired during the Terminal Archaic, having become well established by the subsequent Formative period beginning around 3.5 cal ka (Browman et al. 2018; Bruno 2006; Bruno and Whitehead 2003; Langlie and Capriles 2021; Marsh 2014; Miller et al. 2021; Pearsall 1989; Smith 1980). All of these observations are restricted to the northerly regions of the wet puna, indicating that agricultural economies did not take hold in the dry puna to the south.

Several scholars favor a model in which camelids were domesticated in tandem with plants in the central Andes (Kuznar 1993; Langlie and Capriles 2021; Pearsall 1989; Rick and Moore 2012). Although evidence suggests limited camelid management during earlier periods, the practice became widespread during the Terminal Archaic period (Dransart 2002; de France 2016; Marsh 2014; Noe et al. 2025; Mengoni Goñalons and Yacobaccio 2006; Moore 2016; Wheeler 2012). Lithic data support this timing. Hide-processing tools declined precipitously in the Terminal Archaic components of the Asana, Pachamachay, and Telarmachay assemblages, signaling the replacement of hide-tanning technologies with wool production (Aldenderfer 1998:269; Lavallée et al. 1995:187–188; Rick 1980:298–299). Unlike plant domestication, which was restricted to the north-central highlands, camelid domestication was widespread throughout the Central Andes.

These data align to support models of coevolutionary dynamics in the process of Andean plant and animal domestication, at least in the north-central highlands. Importantly, the domesticated varieties of camelids show clear selection for enhanced wool production (Dransart 2002) and less selection for increased body size (de France 2016; Moore 2016), which relates to meat production. The aforementioned decline in hide tanning practices corroborates a model in which wool production was the selective focus of early herders. The production of dung for fuel—again, a thermoregulatory motivation—may have also contributed to the domestication process (Winterhalder et al. 1974).

With a new and remarkably diverse economic base of foraging, farming, hunting, and herding, Terminal Archaic populations began to experiment with a series of new technologies. The region's earliest ceramics are evident in low frequencies beginning around 4.5 cal ka at Jiskairumoko (Craig 2012), Kotosh (Izumi 1971), and La Galgada (Grieder and Bueno Mendoza 1985). And although hunting appears to have had continued importance, a sharp decrease in projectile point size suggests that archery technology may have first appeared alongside atlatl technology during this time (Kitchel et al. 2022). The use of stemmed points continued, albeit much smaller in size (Figure 24.4s–v), and small triangular points (Figure 24.4w–z) appeared during the Terminal Archaic. Although the continuation of stemmed points suggests a degree of cultural continuity with preceding highland populations, the appearance of triangular points coincides with genetic evidence for a population influx from North America into the central Andes around 4 cal ka (Posth et al. 2018), suggesting a combination of endogenous and exogenous sources of culture change.

Housing technology also shows signs of change at this time. Simple pole-frame huts continued to be used for housing (Aldenderfer 1998; Craig 2012; Rick 1980), but some

communities began to experiment with stone masonry dwellings. Circular masonry houses date as early as 5–4 cal ka at Tulán 52 and Puripica 1 in the Atacama highlands (Núñez 1981). A single masonry structure—likely a dwelling—with internal fire hearths was observed at Pachamachay dating to 4 cal ka (Rick 1980), and masonry architecture is well known among the Terminal Archaic components of Kotosh sites (Burger and Salazar-Burger 1986; Grieder and Bueno Mendoza 1985; Izumi 1971). The limited appearance of masonry dwellings coupled with ceramic technology suggests that some communities were becoming increasingly sedentary, or perhaps more precisely, some sites became loci of continuous occupation by otherwise mobile individuals (Haas 2021; Kitchel et al. 2022).

Communal architecture also showed signs of change. At Asana, communal architecture increased in size around 5.3 cal ka (Aldenderfer 1990). Rectangular prepared clay floors—the largest iteration of which covered at least 100 m^2—were associated with post molds, masonry "altars," clay basins, and hearths. Further to the north, small but elaborate communal rooms began to appear around the same time and are collectively known as the Kotosh tradition. Preceramic levels at Kotosh, La Galgada, and Huaricoto reveal chamfered square masonry structures, each covering up to 100 m^2 (Burger and Salazar-Burger 1985; Grieder and Bueno Mendoza 1985; Izumi 1971). These structures contain circular central hearths set in split-level floors and plastered walls with small niches. One structure at the type site of Kotosh includes a plaster frieze depicting crossed arms (Izumi 1971).

At La Galgada, a large complex of ceremonial architecture was constructed between 4.9 and 4.2 cal ka (Grieder and Bueno Mendoza 1985). Two mounds formed accretionally as the inhabitants built square structures, which were eventually converted to filled burial tombs and served as platforms for subsequent structures. The tombs contained females, males, adults, and children, suggesting a relatively egalitarian social structure, or at least nongendered ritual practice. The resultant site complex contained a series of circular courts and two large, multitiered masonry platform mounds supporting ritual structures on top and tombs within. It is clear that the Kotosh and Asana structures were not domestic given the absence of domestic refuse. Low-intensity burning rituals were pervasive as is the case in contemporary Aymara and Quechua ritual tradition. Whatever the specific activities, the communal structures collectively signal the ascendance of complex ceremonial architecture for new community traditions during the Terminal Archaic period.

Populations also took on a new interest in acquiring exotic goods for economic and prestige-related goals. Cold-worked gold and copper appeared during this period (Aldenderfer et al. 2008). Polished stone beads similar to forms in early coastal sites occur with marine shell and fish bone in the early levels at Huaricoto, indicating long-distance exchange networks in the northern highlands (Burger and Salazar-Burger 1985). Highlanders began to acquire obsidian from distant sources during the Terminal Archaic period (Craig 2012; Rick 1980; Stanish et al. 2002). Some individuals were interred with these costly, showy goods as at Jiskairumoko, and others received mound burials as in the case of La Galgada (Grieder and Bueno Mendoza 1985) and Kaillachuro (Craig 2011; Flores Blanco 2014). A remarkable adult male burial at Huachichocana, 3.6 cal ka, is associated with dozens of finely crafted objects, including two wooden atlatls, a coiled basket, ground-stone cylinders, wood and stone pipes, necklaces, rattles, carved wood bird effigies, feline claws, bird feathers, turtle shell, a camelid cranium, wood fire-starting tools, projectile points, scrapers, and other stone and bone tools (Fernández Distel 1986). This suite of observations suggests that individuals and family lineages of these early agricultural societies began to

experiment with new economic opportunities and power dynamics. However, social inequality remained at low levels throughout the Terminal Archaic (Aldenderfer 2005).

The persistence and expansion of artificial cranial modification and communal architecture throughout this period of agricultural origins and economic innovation suggests that they were part of a new norms of cooperation that ultimately resolved the classic problem of common-pool resource management (Hardin 1968). The ostensible appearance of archery technology may have further contributed to the process of socioeconomic reorganization by enhancing the defensibility of land, herds, and food stores (Flores-Blanco et al. 2024). The Terminal Archaic period was thus a dynamic period, at once marked by conflict, innovation, and social transformation. Understanding the nuances of these dynamics remains a major analytical challenge of Andean archaeology (Aldenderfer 2005, 2012; Craig 2012; Kitchel et al. 2022).

Conclusion

Highland foragers of the Central Andes reveal a remarkable trajectory of human adaptation and transformation. Over the course of 10 millennia, they drew upon technological and social innovations and genetic adaptations to solve the challenges of high-altitude living, food production, and village life. However, the trajectory was not linear. It was fraught with ecological disaster and violence. Nonetheless, highland foragers ultimately prevailed, establishing permanent communities in the highlands 11,700–9,000 years ago and norms of cooperation that facilitated technological innovations in agriculture, textiles, ceramics, metals, architecture, and archery 5,000-3,500 years ago. These cultural developments became the foundations of Formative period cultural systems and, ultimately, Andean urbanism as seen among the Tiwanaku, Wari, and Inca cultures (Bandy 2006; Capriles 2014; Hastorf 2008; Janusek 2004; Miller et al. 2021; Stanish 2003). Such innovations persist among contemporary central highland communities, including the Aymara and Quechua. Highland foragers have even influenced global culture, lest we forget that some of the world's most economically important and culturally iconic resources—potatoes, quinoa, llamas, and alpaca (Earle 2020; FAO 2021; Fritz et al. 2017; Vilá and Arzamendia 2020)—are the innovations of highland foragers of the central Andes.

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