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Zooarchaeology and Changing Food Practices at Carrizales, Peru Following the Spanish Invasion

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Abstract Through analysis of zooarchaeological remains from two occupations at the site of Carrizales, we examine how an indigenous Peruvian maritime community responded to imperial interventions in their daily lives in the late sixteenth century. Following their forced resettlement into a planned *reducción* village, and amidst demographic decline and tribute extraction, Carrizales's residents significantly changed how they put food on the table, pursuing less time-intensive strategies of food collection and incorporating Eurasian animals into their diets. These results illustrate the dynamism of relations between imperial political economies and domestic life and the efficacy of indigenous survival strategies.

Keywords Andes · Zooarchaeology · Spanish colonialism · Forced resettlement

Introduction

Archaeologists have demonstrated that imperial expansions often precipitate changes in household economies among conquered peoples (Bray 2003; Brumfiel 1991; D'Altroy and Hastorf 2001; Evans 1993; Hastorf 1991; Herrmann 2011) and that variation in imperial strategies, the dynamics of local resistance, and the biological parameters of imperial expansion hold distinct implications for households in conquered regions (Deagan 1974, 2001; Voss 2008a, 2008b, 2008c).

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One way of describing variation in how indigenous households articulate with expanding imperial political networks is the distinction between "direct" and "indirect" interventions in local political economies (Covey 2000; D'Altroy 1992; Morrison 2001; Parker 2001; Sinopoli 1994). Direct interventions include major reorganizations of political hierarchies and tributary systems, while indirect interventions largely leave local administrative structures intact, often to ensure continuity in the production of goods and the procurement of labor for tribute (Brumfiel 1991; D'Altroy 1992; Gose 2003; Hastorf 1990; Schreiber 2001; Stanish 1997; Van Buren 1996). While the distinction between direct and indirect strategies has primarily addressed the relationship between imperial and conquered administrations, imperial strategies (and their unanticipated consequences) also hold implications at the household level. In particular, variations in imperial political and tributary regimes may pose distinct challenges to household subsistence activities.

The archaeological remains of indigenous domestic sites in the Spanish colonial Americas present a diverse array of cases for examining the impacts of one Early Modern empire on food practices and household social life. Considered as a whole, the Spanish and Portuguese invasions arguably posed uniquely severe challenges for subsistence activities among indigenous households (Cook 1981; Cook and Lovell 2001; Crosby 1972, 1986; Lovell 1992). However, case studies by historical archaeologists working in the colonial Americas have illustrated how changes in household economies associated with imperial incorporation and resistance varied greatly based on region and settlement, if not also across domestic units within the same communities (Deagan 1996; deFrance 1996; deFrance 1993; deFrance and Hanson 2008; Gifford Gonzales 2010; Pavao-Zuckerman 2010; Pavao-Zuckerman and LaMotta 2007; Reitz 2001; Reitz 1990; Reitz et al. 2010; Rodríguez-Alegría 2005; Spielmann et al. 2009; VanderVeen 2006; Wernke 2013).

In this essay, we present a study of household economic change within a late sixteenth century indigenous community in Peru's North Coast region. In late prehispanic times, the North Coast was home to dense populations of farmers, fishermen, and urban craft specialists. By late prehispanic times, it contained an estimated two-thirds of all the irrigated land on the Peruvian coast, and was home to complex urban communities (Dulanto 2008; Kosok 1965; Shimada 1990; Ramírez 1996; 2007). Yet few regions of Western South America experienced more acute changes in the wake of Spanish colonization. The area's rich soils, well developed canal systems, and geographic accessibility quickly made its populations a prize for Spanish *encomenderos* as early as a few years after the initial invasion of the continent (Ramírez 1986). Subsequently, all major trade routes linking Lima to Panama, Europe, and the Caribbean passed through its ports and administration centers. In the mid seventeenth century, the North Coast (along with the neighboring highland region of Cajamarca) was subject to one of the Americas' earliest widespread campaigns to forcibly resettle indigenous people, carried out during the *visita* (census) of the administrator Gregorio González de Cuenca in 1566–67. Together, interaction with Europeans and settlement nucleation may have been responsible for accelerating disease transmission among native communities. By the mid 17th century, the region's aggregate indigenous population had declined by an estimated 72 % after a series of devastating epidemics (Cook 1981, p. 118).

The examination of how indigenous subsistence practices shifted in the wake of Spanish colonization can help us to understand how communities dealt with the challenges posed by these overlapping processes. Here, we concentrate on analysis of vertebrate faunal remains from two sectors at the maritime site of Carrizales, in the lower Zaña Valley – 1) Conjunto 123, a colonial planned town (*reducción*) established by Spanish forced resettlement initiatives between 1566 and 1572 and abandoned approximately three decades later; and 2) Conjunto 125, an earlier, prehispanic fishing village dating to the Late Sicán/Lambayeque period (1150–1350 CE). We document remains collected from middens, identify vertebrate taxa present in each context, and provide evidence for changes in food processing techniques. In the context of our argument, excavations and analysis of materials from the late Sicán occupation of Conjunto 125 provide a productive counterpoint for understanding domestic patterns within the colonial *reducción*, Conjunto 123.

Our analysis suggests that the people of Carrizales fundamentally reorganized their subsistence practices in the wake of Spanish colonization and resettlement. In comparison to the Late Sicán sample, food remains from the colonial *reducción* demonstrate a drastic decrease in marine species richness and diversity, as well as an increase in terrestrial species richness and diversity, in conjunction with the introduction of desert-adapted Eurasian domestic animals such as chickens, geese, sheep, and goats.

Despite the imbalances of social power engendered by the Spanish invasion, we argue that changes in economic activities manifested in plant and animal remains at Carrizales cannot be attributed merely to forcible, “direct” interventions in household organization. Rather, they are better understood as the results of *strategic adaptations* pursued by indigenous households to ensure their survival amidst a series of novel challenges, including new tributary demands, declining labor availability, and the loss of traditional knowledge.

Historical and Geographic Settings

The North Coast is a sub-region of Peru’s coastal desert, located between approximately 6° 50′ S and 9° S latitude, crosscut by a series of verdant river valleys fed by waters that descend out of the Andes mountains. With a broader coastal plain and rivers with higher flow rates than areas further south along the Pacific coast, the valleys of the North Coast support larger agricultural enterprises than neighboring coastal regions, and extensive canal systems have added irrigated territory for cultivation from at least the Early Intermediate Period (0–600 CE) and perhaps as early as the late Preceramic period (Dillehay et al. 2005). Within this region, the Zaña valley is a relatively minor drainage whose lower reaches form a portion of the Lambayeque complex, a series of five separate river valleys linked by canals from as early as Early Moche times (200–400 CE) (Nolan 1980) (Fig. 1).

The archaeological record of settlement in the Zaña valley suggests that its peoples experienced many of the same social and political transformations during later prehistory as the core valleys of the Lambayeque region. Following the decline of the late Moche site of Pampa Grande around 750 CE, and a 150-year period of subsequent political fragmentation, the political and ceremonial center of Batán Grande, in the La Leche drainage, became the center of gravity in the Lambayeque region during what is known as Middle Sicán/Lambayeque times, from 900 to 1100 CE (Castillo Butters 2000; Shimada 1994). Elaborate mold-made ceramics and copper-alloy artifacts

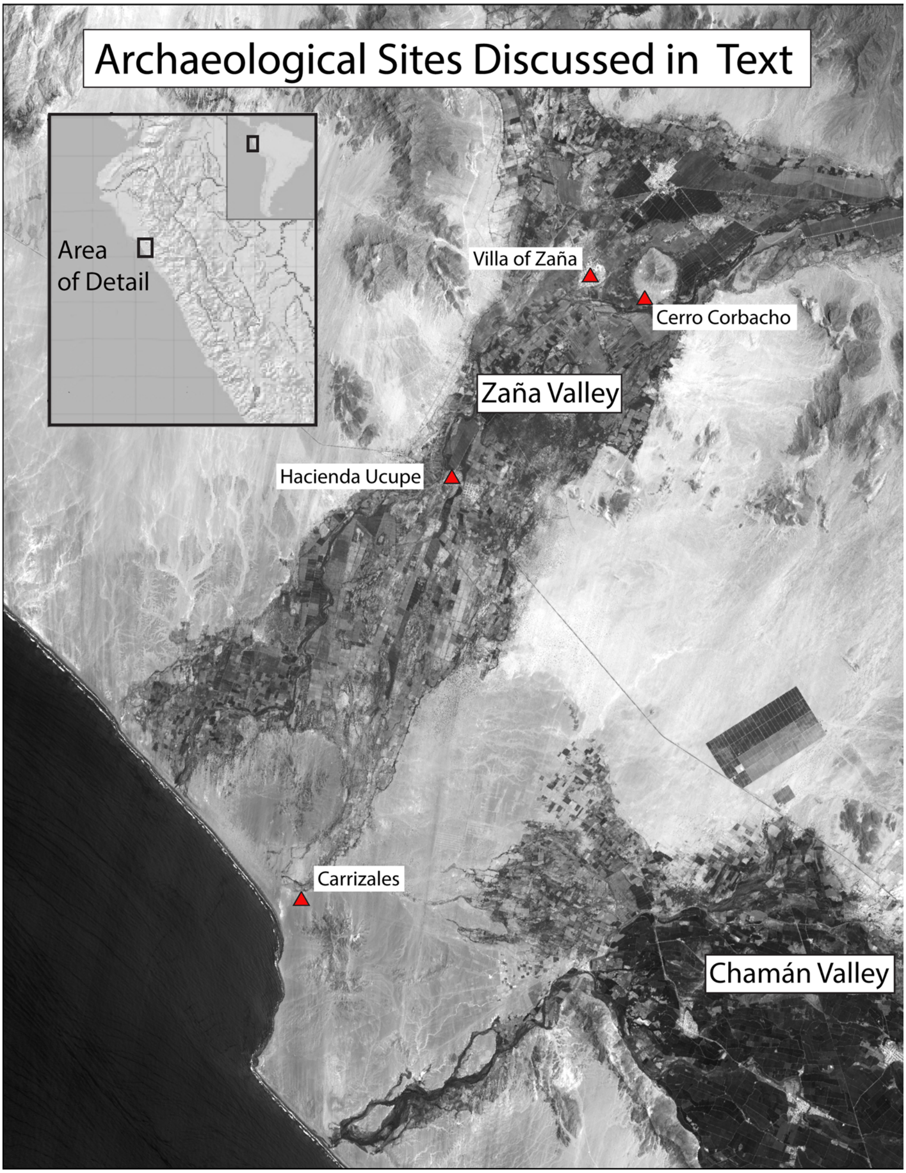

Fig. 1 Map of Zaña and Chamán Valleys, Peru, and sites mentioned in text

manufactured at Batán Grande were exchanged throughout the Lambayeque valley complex and valleys further south, and t-shaped chamber-and-fill mounds, as well as tamped earth enclosures, sprung up at smaller centers across the region (Shimada 1982; Shimada 1990; Tschauner 2001; Shimada et al. 1982). Around 1100 CE, Batán Grande declined and Túcume became the regional hegemon during the succeeding Late Sicán Period (ca.1100–1350) (Heyerdahl et al. 1995; Shimada 1990). Circa 1350 CE, the Lambayeque region was incorporated into the expanding Chimu political sphere (Rowe

1948; Topic 1990). and was subject to Inka rule after 1450 CE following the latter's conquest of the Chimu (Hayashida 1995, 1999; Mackey 2010; Ramírez 1990; Rostworowski de Diez Canseco 1990).

Throughout the remainder of this essay, we use the terms "Middle Sicán" and "Late Sicán" as chronological markers established through the work of Shimada and colleagues, whose ceramic typology we employed in an evaluation of regional settlement patterns in the Zaña Valley (VanValkenburgh 2012). In contrast, we use the term "Lambayeque" to refer to the style of architecture and ceramics produced at Batán Grande, Túcume, and other late prehispanic urban centers before the advent of Chimu hegemony in the Lambayeque valley region in the fourteenth century.

Within the lower Zaña valley, regional survey reveals a great deal of continuity in settlement patterns between Middle Sicán and Inka times. Small ceremonial centers were abandoned and/or refashioned at moments of major political transition, but residential settlement remained disperse, clustered along the valley's left and right side canal systems. Successive hegemons refashioned the site of Cerro Corbacho while maintaining it as the chief administrative center of the valley (VanValkenburgh 2012, pp. 331–336). The Inka established administrative outposts along the coastal trunk road, at the site of what would later be the colonial villa of Zaña and at the so-called *tambillo* of Zaña, just beyond the current margin of valley vegetation (Kosok 1965; Kroeber 1930). The paucity of both Chimu and Inka ceramics in lower valley settlements suggests that these polities' interventions in the organization of production and daily life was relatively small-scale, and that tribute may have been extracted through indirect means by mobilizing political ties established during the previous Middle and Late Sicán periods (Cleland and Shimada 1998). However, the absence of local tribute lists dating to the first two decades after the Spanish invasion challenges detailed reconstruction of Inka tributary regimes. Their most salient contrast with subsequent colonial period tributary systems is that obligations to the Inka seem to have been registered primarily in terms of labor, rather than kind (D'Altroy 2002, p. 207; Ramírez 1986, p. 163).

Ethnohistorians have suggested that late prehispanic residents in the valley were organized into a nested hierarchy of *parcialidades* (sections) – sodalities defined by kinship and alliances rather than territorial contiguity, in which leaders received and aggregated tribute and delivered it up administrative hierarchies (Netherly 1993; Ramírez 1985; 1996; Rostworowski de Diez Conseco 1981). Many *parcialidades* incorporated communities of varying economic specialization, from farmers and fishermen to craftspeople such as potters and silversmiths, though scholars have disagreed about the degree of specialization among these residential units (Cock 1986; Prieto 2011; Ramírez 1982; Rostworowski de Diez Canseco 1977; Ramírez 2007; Sandweiss 1992). While current evidence does not allow for the reconstruction of the distinct political affiliations of the Late Sicán population of Carrizales, the site's economy (as we outline below) was strongly oriented towards the extraction of maritime resources, and it may have formed part of a series of economically complementary communities under the rule of a single local ruler. Given the level of centralization present in Late Sicán settlement, and documentary references to the complexity of Lambayeque society when the region was conquered by the Chimu, it is highly likely that the Late Sicán residents of Carrizales formed part of regional tributary networks.

Political transformations in the region continued after the Spanish Invasion, which was initiated when Francisco Pizarro's third expedition to western South America arrived late in the year of 1531 with a company of approximately 200 men in the recently destroyed Inka administrative center of Tumbes. Marching south several months later, they followed Inka roads south through Lambayeque and turned East into the Andes upon reaching Zaña, towards their fateful meeting with the Inka Atawallpa at Cajamarca. Over the course of the next three decades, Spanish political institutions made halting advances into the North Coast region. Cities were founded at Tumbes, San Miguel de Piura, and Trujillo, and buildings housing religious institutions were erected at their centers. Tribute was redirected to Spanish *encomenderos*, who were granted rights to the labor and tribute of indigenous groups (Ramírez 1996). The reorganization of economic networks and increasing mortality due to the spread of Old World infectious diseases led some indigenous people to migrate to emerging Spanish urban centers, such as Lambayeque (Cook 1981), but indigenous settlement remained primarily disperse and *encomenderos* wielded a great deal of power in rural areas.

While indigenous communities in the Lambayeque region were by no means unaccustomed to rendering tribute, the range of products and services they were asked to deliver to their overlords expanded with the rise of the *encomienda*, as well as the introduction of Eurasian domesticates into local foodways and production regimes. In 1564, the community of Chérrepe, which we argue included the residents of Carrizales, owed 13 different forms of tribute to its *encomendero* – 900 pieces of finished cloth, two cotton beds, 36 *fanegadas* of wheat (in the form of 4680 lb [2123 kg] of flour), 1000 birds, eggs, fish, salt, pigs, and an unspecified amount of *algarrobo* (mesquite) wood (AGI Patronato 97A R.4 15-17v; Ramírez 1996, p. 106). In addition, they were asked to provide 15 *indios de mita* (native laborers) and 14 shepherds per year, in order to tend to tasks and property belonging to the *encomendero*. Calculated by its monetary equivalent, the total amount of tribute Chérrepe owed between 1548 and 1569 varied between a minimum of 1300 and a maximum of 4700 pesos per year (Ramirez 1996, pp. 96–98, pp. 105–106).

As indigenous populations shifted due to disease and internal migration, tributary levels were theoretically adjusted in order to make them more manageable. However, readjustments were infrequent, and indigenous tributaries often appear to have struggled to fulfill their obligations (Ramírez 1996). Indeed, the extant copy of Chérrepe's 1564 tribute list is preserved because it was included in a legal claim made by the widow of the *encomendero*, Francisco Pérez de Lezcano, for unpaid tribute she claimed that the natives still owed her some 10 years after it was due.

In the 1560s, the Peruvian viceroyalty began to play a more active role in shaping landscapes, histories, and structures of governance outside of Spanish urban centers, in part based on efforts to reign in the power of the *encomenderos*. The desire to intensify silver mining at Potosí, to hold back the perceived threat of indigenous millenarian movements, and to respond to the pressures of the Counter-reformation also encouraged direct interventions in settlement patterns and tributary regimes (Durston 2007; Matienzo 1967; Mumford 2012; Stern 1982). Seeking to foster the growth of a Spanish agricultural class in the region, the viceroyalty erected the villa of Zaña in 1563, on the site of the valley's primary Inka *tambo* (Angulo 1920; Harth Terré 1964; Ramírez 1978; Ramírez 1986). Within 20 years, the *villa*'s population included dozens of *vecinos* (property owning citizens), several convents, and hundreds of citizens.

More direct interventions in indigenous daily life began when the *oidor* (judge) Gregorio Gonzalez de Cuenca conducted the first systematic regional survey of the province of Trujillo in 1566–67 and began halting initiatives to reorganize dispersed indigenous populations into new settlements, with the goal of facilitating their social reordering and catechism (Noack 1996, 2004; Rostoworowski de Diez Canseco 1975; Van Valkenburgh 2012, pp. 291-546). Spanish administrators and clergy had deliberated on the possibility of resettling native people into planned towns since almost the inception of colonization in the Americas, and various actors – Franciscan friars, in particular – had engaged in small-scale resettlement campaigns in the Viceroyalties of New Spain (Mexico, Central America, and the Caribbean) and Peru (Cummins 2002; Gerhard 1977; Hanks 2010; Kagan 2000; Quezada 1993; Wernke 2010). Within Peru, however, Cuenca was the first administrator to attempt to carry out resettlement within a whole region – one that comprised the coastal districts of Trujillo and Piura, as well as the adjacent highland provinces of Huamachuco, Cajamarca, and Chachapoyas. Yet he appears to have stopped short of completing the task after he was accused of illegally carrying out the execution of a native lord. Records of his ensuing trial of office, or *residencia*, document his injunctions to nucleate indigenous settlements in coastal valleys, including Zaña and Chamán (AGI Justicia, pp. 456–459).

Attempts to empirically document the effects of the Cuenca *reducción* initiative have been challenged by the subsequent, larger-scale resettlement carried out under the guidance of Viceroy Francisco de Toledo, the *reducción general*. Conceived in 1569 and inspired in part by Cuenca's initiatives and the writings of the jurist Juan de Matienzo (1967), Toledo's resettlement program sought to nucleate the entirety of Peru's indigenous populations into planned towns, each of which would be organized along a rectilinear grid of streets, with a plaza, a church, and a series of civic institutions located at their center (de Toledo 1867; 1986). Indigenous extended families would be rearticulated into nuclear units, with single doors leading onto the street to facilitate their surveillance. Houses would be divided up so that parents, sons, and daughters would sleep apart from one another and therefore not observe their parents "behaving immodestly" and "growing lewd and lascivious" (Matienzo 1967, pp. 24; in Cummins 2002, pp. 217). So arranged, native people would be instilled with *policía*, a sense of order and discipline, allowing them to be more easily observed and catechized.

In the lower Zaña and Chamán valleys, the Toledan *reducción* program congregated populations within three major sociopolitical units – the *cacicazgo* of Zaña, centered in the upper portion of the lower valley, near the *villa*; Mocupe, a *parcialidad* of Zaña whose residents lived further down valley; and Chérrepe, headed by a cacique of the same name and centered on settlement located alongside the sea. Subjects of the cacique of Zaña were settled around the *villa*, as well as in a settlement named Leviche or Liviche, one league to the south (Angulo 1920; AGI 461 1578v). Subjects of the *principal* Mocupe were settled in the *reducción* of Mocupe Viejo, on the northern slopes of Cerro Purulén. Along the coast, the residents of several settlements were re-congregated within the head town of Chérrepe, located between the Chamán and Zaña valleys (Ramírez 1978).

It is in this littoral portion of the valley that Carrizales is located, and we suggest that the site's colonial period occupation – represented by an artifact scatter and a series of structures covering 8.95 ha, which we label Conjunto 123 – corresponds to the remains of the first *reducción* of Chérrepe. According to the 1572 census of Chérrepe, conducted in conjunction with that community's resettlement, its *cacique* lived in a coastal village and was head of a *parcialidad* dominated by fishermen (Ramírez 1978). The members of six other *parcialidades* paid tribute to him and were settled in at least three additional villages – at least one of which might have been established by Cuenca's earlier *reducción* initiative. Following resettlement, these subjects were all congregated within or near the cacique's village. Previous discussions have suggested that this village was located at the Caleta de Chérrepe, the site of Zaña's port from the late sixteenth through late eighteenth centuries (Ramírez 1996). However, that site covers an area (3.5 ha) that is considerably smaller than the mean size (ca. 10 ha) of other *reducciones* in the region. Carrizales, located six kilometers to the north of the Caleta de Chérrepe is a more likely candidate.

In summary, social and political processes initiated in the early colonial period held profound implications for indigenous domestic economies in the lower Zaña valley. Even before Pizarro's forces landed at Tumbes, epidemics of Old World diseases decimated coastal populations, shrinking labor pools available for both subsistence and tributary production. New species of plants and animals offered novel solutions to the challenges of making a living in the coastal deserts and began to transform local landscapes. Changes in tributary goods demanded new patterns of food production, and resettlement sought to redefine the residential units in which food resources were collected and prepared. Despite the scale of these changes, however, the preponderance of documentary sources that describe social life during the period offer few clues about their concrete impacts on indigenous daily life. Archaeological excavations of domestic structures and the analysis of food remains therefore provide crucial information for understanding the dynamic relationship between Spanish imperial political economy and native households.

Archaeological Research at Carrizales

Carrizales is a series of domestic occupations and cemeteries located along the Pacific Coast at the mouth of the seasonal Río Carrizal, spread out over an area of approximately one square kilometer. Alongside the site, the waters of the Río Carrizal are brackish, and the nearest fresh water is a spring located some 5 km to the north, near the Zaña River. Still, the conjunction of brackish and salt water resources near the site would have provided a greater range of foodstuffs and economic plants to its inhabitants than other coastal locations. Moreover, abandoned prehispanic canal courses that pass within two kilometers of the site to its east suggest that Carrizales's residents may have had access to an additional source of fresh water in antiquity. Today, the site continues to be visited by fishermen from the Zaña and Chamán regions, as well as the nearby city of Chiclayo and its surrounding settlements.

Systematic surface collections within this landscape suggest shifting occupation dating from at least the Early Intermediate period (200–750 CE) through early colonial times (VanValkenburgh 2012). While the Carrizales landscape is the single largest concentration of maritime settlement that VanValkenburgh's (2012) regional survey of the lower Zaña valley recorded, it contains no evidence of monumental architecture other than the crumbling remains of a humble chapel within the colonial *reducción*. Thus, rather than a regional ceremonial or administrative center, the area seems to have been a nucleus for modestly sized maritime domestic occupations and burials for nearly two millennia.

In the 2012 and 2014 field seasons of the Proyecto Arqueológico Zaña Colonial, VanValkenburgh and colleagues carried out horizontal excavations at Carrizales within three distinct "conjuntos" – discrete areas with surface ceramic densities above one sherd per square meter and at least one other surface artifact type: 1) Conjunto 125, a locus of late prehispanic domestic occupation with remains dating to the Late Sicán period; 2) Conjunto 131, a Late Sicán midden; and 3) Conjunto 123, a *reducción* whose remains indicate that it was abandoned before the end of the sixteenth century (Fig. 2). Located near the northern edge of the Carrizales landscape, Conjunto 125 is an area of relatively high artifact density, whose situation atop an elevated terrace suggested that it might be a propitious location for finding late prehispanic domestic structures. Conjunto 131 is a dense accumulation of shells, stone artifacts, and late prehispanic ceramics located just to the northwest of Conjunto 125, atop what appears to be a naturally-formed sand dune. Conjunto 123, 700 m to the east, contains a surface assemblage characterized by late sixteenth century ceramics – paddle-stamped domestic wares and local finewares, as well as small numbers of fragments of foreign-made glazed serving vessels, including Panama Plain majolica, Sevilla blue-on-blue majolica, and Ming porcelain.

Pedestrian and geophysical survey at Conjunto 123 identified several characteristic features of a *reduccion* – the remains of a small chapel, a central area of low magnetic activity and surface ceramic density that we interpret as a plaza, and series of rectilinear

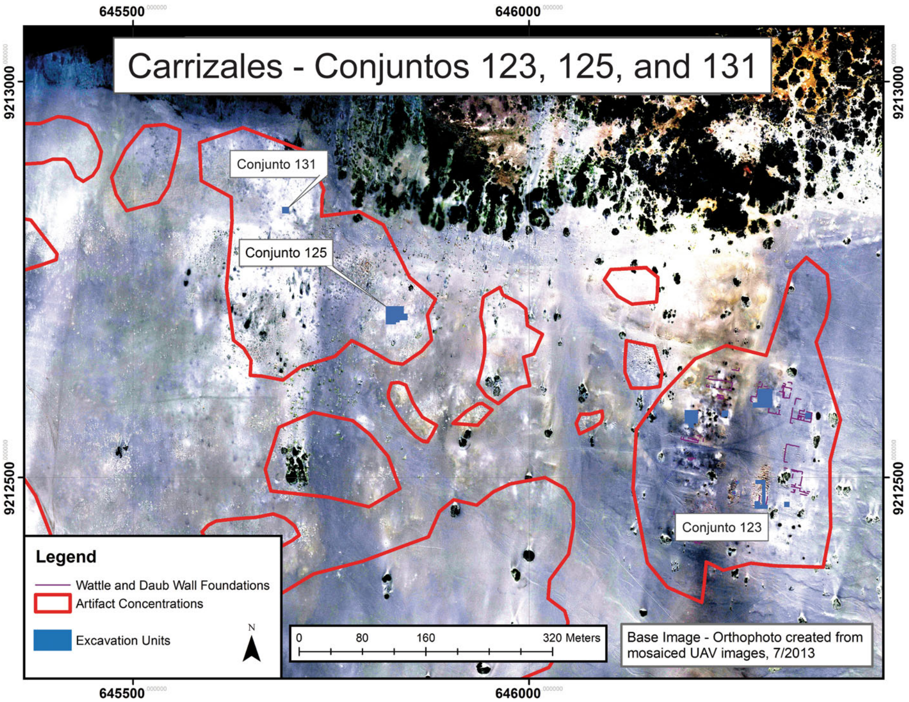

Fig. 2 Map of Carrizales, showing Conjuntos 123, 125, and 131, as well asunits excavated in 2012 and 2014

housing blocks visible as areas of differential drying on the site surface, abutted by small middens occupying only a few square meters each (VanValkenburgh et al. 2015). These features, and the absence of earlier prehispanic occupation within Conjunto 123, suggest that it was established by either the Cuenca or Toledo resettlement programs, between 1566 and 1572. Excavations conducted in 2012 and 2014 confirmed that Conjunto 123's remains date exclusively to the late sixteenth century, and that rectilinear features visible on its surface demarcate shallow trenches dug to accommodate the bases of *quincha* (wattle and daub) walls. The presence of overlapping patterns of *quincha* trenches in our excavation units suggest at least one remodeling event at Carrizales. Based on estimates of the durability of contemporary *quincha* structures, we estimate that the site was occupied for at least 10 years. However, the absence of characteristic seventeenth century ceramics present in other sites within the region (including Panama blue-on-white and Panama Polychrome Type A ceramics) suggest that the *reducción* at Carrizales was abandoned less than three decades after its founding.

Excavations at Conjuntos 125 and 131 were designed to provide a pre-*reducción* point of comparison for patterns at Conjunto 123. While 300 years separate the two occupations, we argue that excavations in the Late Sicán sector offer a productive contrast that illuminates the effects of Spanish colonial transformations on native subsistence and social conditions. While comparing colonial food remains and domestic space to terminal prehispanic materials would offer a more direct point of comparison, we argue that there is no fixed late prehispanic "baseline" by which Spanish colonial transformations might be best evaluated. Rather, the archaeology of the lower Zaña valley suggests that the political subjectivity of local communities constantly evolved between 950 and 1532 CE, as the region's peoples competed with one another and were incorporated into a series of expansive polities. Their households and subsistence practices were dynamically related to these political developments – shifting over the course of a series of successive political transformations, from the growth of *cacicazgos* to the establishment of Lambayeque, Chimu, and Inka hegemony in the valley.

In practice, our excavations targeted the recovery of data that would allow us to explore changes in both foodways and the organization of domestic space within the prehispanic and colonial sectors of Carrizales. In the first two field seasons of excavation at the site, in 2012 and 2014, the Proyecto Arqueológico Zaña Colonial excavated ten separate units, including eight at Conjunto 123 – three in middens (Units 123-002, 123-006, and 123-009), three in the church precinct (123-001, 123-003, and 123-011), and two uncovering the floor plans of large houses (123-005 and 123-007, covering 325 m^2 and 250 m^2, respectively) (Fig. 2). At Conjunto 125, excavations have focused on a single 350 m^2 unit, uncovering the floor plan of a large house and surrounding middens. Finally, we have conducted a limited (5 × 5 m) test excavation in Conjunto 131. The total volume of material excavated from Conjunto 123 is approximately 1.5 times more than that excavated from Conjunto 125 – a factor discussed in further detail below.

Detailed discussion of the architectural patterns recovered by our excavations is beyond the scope of this essay, but some basic description provides context for understanding the results of faunal analysis. At Conjunto 123, excavations in the town sector revealed superimposed *quincha* foundation trenches, storage pits (many of which appear to be the impressions of ceramic vessels removed after occupation), and three large pit hearths within one structure. Refuse deposits are disperse at Carrizales: more than two dozen individual concentrations of charcoal and food trash are located at the edges of domestic structures, and three of these were sampled during our excavations. Excavations at Conjunto 125 reveal similar architectural features – *quincha* foundation trenches corresponding to at least two separate building episodes, as well as small cooking areas, refuse pits, and negative impressions of ceramic vessels that had been embedded in the floor. Trash is concentrated in a large, dense area to the north of the exposed housing structure. Four radiocarbon dates (Beta 366921 to 366924) obtained from maize kernels and wood charcoal from the site date to between 1160 and 1280 Cal AD, including two-sigma error ranges, placing the occupation squarely in Late Sicán times (VanValkenburgh et al. nd). At Conjunto 131, excavations recovered a dense concentration of faunal remains to a depth of approximately 30 cm, below which cultural deposits ceased and natural sand layers were present.

Sampling strategies in each of these excavations sought to recover substantial amounts of faunal and botanical material. Excavation employed a single-context recording system with a high degree of spatial precision (Harris 1979). All excavated loci were field-screened using 1/16 in [1.52 mm] sieves, and five-liter bulk samples were collected from all non-superficial loci for botanical and zooarchaeological analysis. During the 2014 excavation season, 20-liter bulk samples were collected from zooarchaeologically rich contexts, in order to increase recovery of material for zooarchaeological analysis. Each bulk sample was processed using 4.0, 2.0, 1.0, and 0.5 mm sieves, and zooarchaeological remains were extracted from each sample by hand.

Faunal Analysis

Methods

Kennedy completed initial faunal identifications at the Proyecto Arqueológico Zaña Colonial (PAZC) zooarchaeology laboratory in Lima, Peru. Positive identifications were completed using the PAZC vertebrate comparative collections in Lima, Peru, as well as comparative collections at the Museo de Historia Natural at the Universidad Nacional Mayor de San Marcos (Lima), the Instituto del Mar del Perú (IMARPE, Lima), and the Proyecto Arqueológico Caral (Lima). All remains were identified to the lowest possible taxonomic level.

The measures of relative abundance calculated include the number of identified specimens (NISP), minimum number of individuals (MNI), and bone weight. MNI was calculated using conservative criteria, such as symmetry, size, and fusion (Reitz 1988; White 1953). MNI for fish remains was calculated using pairs of otoliths, diagnostic and durable calcium carbonate structures located behind the brain of boney fishes (Béarez 2000). In the absence of otoliths, fish MNI was calculated using the procedure describe by Rick et al. (2001) – i.e., dividing the number of vertebrae of the sample by the average number of vertebrae for a species, genus, or family.

Age estimates for mammals were determined through the evaluation of epiphyseal fusion on long bones and tooth eruption, while aging profiles were used for the age estimation of birds. In contrast to estimates of age of death in years, three age categories for mammals were used: juvenile, sub-adult, and adult (deFrance and Hanson 2008).

The term "juvenile" refers to individuals with unfused epiphyses and deciduous dentition, estimated to be less than 6 months of age; "sub-adult" refers to individuals with partially-fused epiphyses and some permanent dentition eruption, estimated to be between 6 months and 1.5 years of age; and "adult" refers to individuals with fused epiphyses and fully developed dentition, estimated to be older than 1.5 years (see Getty 1975). In contrast, only two age categories were used for birds (juvenile and adult), due to the fact that birds mature relatively rapidly (deFrance 2005). Juvenile bird remains are unfused and porous, whereas adult bird remains are ossified and fused. The sex of individual animals was not calculated due to the paucity of remains in the assemblage with diagnostic sexual characteristics.

Mammal and bird butchery and consumption patterns were assessed through the evaluation of frequencies of skeletal portions and cut marks. To differentiate patterns in butchery, three categories were employed: cuts, saws, and hacks. *Cuts* are small incisions with fine striations found in parallel to them, which we interpret as the results of the skinning and disarticulation of carcasses, as well as the removal of meat for cooking and consumption (Shipman 1981). *Saws* are grooved and snapped areas on specimens – a broad definition that encompasses examples of both prehispanic and colonial butchery patterns. We interpret sawing as evidence of either primary or secondary butchering, where *primary butchering* refers to the initial dismemberment of the carcass and *secondary butchering* referring to further subdivision of the meat. *Hacks* are deep, non-symmetrical fragmentations (Noe-Nygaard 1989; Shipman 1981) that provide evidence that a large instrument was employed, most likely during primary butchery.

Skeletal frequencies were also used to determine possible changes in transport, butchery, sharing, and/or disposal. In order to eliminate bias normally found with NISP comparisons, we determined relative frequency of skeletal portions using minimum number of anatomical units (MAU) derived from NISP values. Following Binford (1978), we calculated MAU by determining the minimal number of anatomical units for a given specimen using left and right siding, central shaft overlap, and proximal and distal portions (deFrance 2005). We used seven total anatomical groupings and are as follows: head (skull, mandible, and teeth); axial (ribs and vertebrae); forequarter (scapula, humerus, radius, and ulna); hindquarter (innominate, sacrum, femur, patella, and tibia); forefoot (carpal and metacarpals); hindfoot (tarsals and metatarsals); and foot (metapodials and phalanges).

Species richness and diversity were also assessed. The term *richness* refers to the number of taxa (species) in an assemblage. In contrast, species *diversity* takes into account both the evenness of species' abundance and species richness, and is used here as a measure of heterogeneity in our samples (Reitz and Wing 2008, pp. 110–111). Diversity was calculated using the Shannon-Weaver function with the formula $H'= -\sum (i= 1)^s(p_i)(\log_e p_i)$ (Reitz and Wing 2008, p. 111). MNI was used to quantify the relative abundance of species in the samples. Higher diversity numbers indicate a greater breadth of species diversity in the samples.

Due to small sample size, remains from Conjunto 125 and 131 were analytically combined.

Sample Results

NISP and MNI calculations for fauna recovered at Carrizales are presented in Table 1. The total number of identified faunal specimens in the assemblage is 24,160 and the total weight is 6,694.74 g. The assemblage contains at least 301 individuals from 50 different vertebrate categories. Excavations in the prehispanic sector produced the densest concentration of materials: 18,426 identified specimens representing at least 236 different individuals from 32 vertebrate taxa, weighing a total of 2,679.5 g (see Fig. 3). Excavations in colonial contexts at Carrizales produced an assemblage of 5,734 identified specimens, representing at least 65 individuals from 37 different vertebrate classes, and collectively weighing 4,015.2 g (Fig. 3).

Micro-faunal remains collected from bulk soil samples at Carrizales account for 18 % of the total number of individual specimens in the assemblage (NISP=4,383). The total volume of the bulk samples is 386.2 liters, with 130.1 liters collected from the prehispanic sector and 255.7 liters collected from the colonial sector. Overall, the total volume of soil (both excavated and bulk sampled) is nearly 50 % larger in the colonial sector than in the prehispanic sector. Thus, the high quantity of faunal material recovered from the latter is not the result of sampling bias, but an indication of drastically different subsistence practices during that period.

Due to these notable differences in the total volume of faunal remains excavated in prehispanic and colonial contexts, we use percentages of NISP and MNI rather than absolute number to compare trends between both site sectors. Additionally, due to the fact that NISP is relatively low, we do not compare intra-site sectors in this study.

The prehispanic assemblage contains 15 taxa of bony fish, four taxa of sharks and rays, two lizard and snake taxa, five wild bird taxa, and six mammalian taxa, including both domestic and wild species. Here, we use the term *taxa* to refer to taxonomic categories of variable specificity – for example, family, genus, or species. The colonial sector assemblage, in contrast, contains a greater richness of mammal species (15 taxa) and birds (11 taxa) and fewer bony fish (seven taxa). Mammal species recovered in the colonial assemblage include introduced Eurasian domesticates, as well as marine mammal remains, six additional bird taxa, two shark and ray taxa, and one lizard taxon. Age profiles for mammals and birds show a slightly larger percentage of juvenile and subadult species within the colonial assemblage in comparison to the prehispanic assemblage (Table 2), though the results are not statistically significant (p-value=0.32). Both samples have high frequencies of fused and unfused skeletal elements, indicating both juvenile and adult mammal consumption.

Mammals

Mammal remains recovered from the prehispanic and colonial assemblages demonstrate vastly different species richness and diversity. Species whose remains were recovered from contexts in the prehispanic sector include both Andean domesticates, guinea pig (*Cavia porcellus*) and camelids (Camelidae), as well as wild mammals (fox, rodents, and possible deer). Yet together, there are relatively few mammal remains in the prehispanic assemblage – only 18 % of the total specimens and only 6 % of the total number of individuals (NISP=3,240; MNI=14).

Table 1 NISP and MNI of Vertebrate Fauna at Carrizales

		Conjunto 125				Carrizales			
		Pre-Hispanic sector				Colonial sector			
Taxon	Common name	NISP	%	MNI	%	NISP	%	MNI	%
Muridae	Rats, mice	87	0.5	5	2.1	37	0.6	4	6.2
Cavia porcellus	Domestic guinea pig	133	0.7	3	1.3	3	0.1	1	1.5
Cetacea	Whales	–	0.0	–	0.0	1	0.0	1	1.5
Canidae	Canines	1	0.0	1	0.4	21	0.4	1	1.5
Canis lupis familiaris	Domestic dog	–	0.0	–	0.0	10	0.2	2	3.1
Lycalopex sp.	South American fox	3	0.0	1	0.4	2	0.0	1	1.5
Pinnipedae	Sea lion/seal	–	0.0	–	0.0	25	0.4	2	3.1
Equidae	Horse or burro	–	0.0	–	0.0	4	0.1	1	1.5
Artiodactyla or Perissodactyla	Even/odd toed ungulates	–	0.0	–	0.0	15	0.3	–	0.0
Artiodactyla	Even-toed ungulates	708	3.8	2	0.8	242	4.2	2	3.1
Sus scrofa	Domestic pig	–	0.0	–	0.0	28	0.5	1	1.5
Camelidae	Camelids	116	0.6	2	0.8	1	0.0	1	1.5
Bos taurus	Domestic cattle	–	0.0	–	0.0	4	0.1	1	1.5
Bos taurus or Equidae	Cattle or horse/burro	–	0.0	–	0.0	4	0.1	–	0.0
Caprinae	Sheep/Goat	–	0.0	–	0.0	114	2.0	3	4.6
Small Mammal uid	Unidentified Small Mammal	68	0.4	–	0.0	5	0.1	–	0.0
Mammal uid	Unidentified Mammal	2007	10.9	–	0.0	1872	32.6	–	0.0
Large Mammal uid	Unidentified Large Mammal	117	0.6	–	0.0	361	6.3	–	0.0
Total Mammalia		**3240**	**17.6**	**14**	**5.9**	**2749**	**47.9**	**21**	**32.3**
Galliformes	Chicken order	–	0.0	–	0.0	29	0.5	2	3.1
Gallus gallus	Domestic chicken	–	0.0	–	0.0	72	1.3	7	10.8
Anseriformes	Duck, goose order	–	0.0	–	0.0	4	0.1	1	1.5
Anser anser	Domestic goose	–	0.0	–	0.0	3	0.1	2	3.1
Cairina moschata	Muscovy duck	–	0.0	–	0.0	2	0.0	1	1.5
Spheniscus humboldti	Humboldt penguin	–	0.0	–	0.0	1	0.0	1	1.5
Procellariiformes	Shearwater	1	0.0	1	0.4	–	0.0	–	0.0
Ciconiiformes	Ibis	–	0.0	–	0.0	1	0.0	1	1.5
Pelicaniformes	Pelican	–	0.0	–	0.0	1	0.0	1	1.5
Phalacrocorax sp.	Cormorant	26	0.1	2	0.8	15	0.3	4	6.2
Sula sp.	Booby	1	0.0	1	0.4	6	0.1	2	3.1
Columbidae	Pigeons and doves	95	0.5	1	0.4	–	0.0	–	0.0
Passeriformes	Song birds, perching birds	3	0.0	1	0.4	1	0.0	1	1.5
Small Aves uid	Unidentified small birds	17	0.1	–	0.0	12	5	–	0.0
Aves uid	Unidentified birds	80	0.4	–	0.0	512	8.9	–	0.0
Large Aves uid	Unidentified large birds	44	0.2	–	0.0	105	1.8	–	0.0
Total Aves		**267**	**1.4**	**6**	**2.5**	**764**	**13.3**	**23**	**35.4**

Table 1 (continued)

Taxon	Common name	Conjunto 125				Carrizales			
		Pre-Hispanic sector				Colonial sector			
		NISP	%	MNI	%	NISP	%	MNI	%
Squamata	Snake or lizard	40	0.2	1	0.4	7	0.1	1	1.5
Lacertilia	Lizard	1	0.0	1	0.4	–	0.0	–	0.0
Total Reptilia		**41**	**0.2**	**2**	**0.8**	**7**	**0.1**	**1**	**1.5**
Carcharhinus sp.	Carcharhinus shark	26	0.1	1	0.4	12	0.2	1	1.5
Prionace glauca	Blue shark	1	0.0	1	0.4	–	0.0	–	0.0
Mustelus sp.	Hound shark	1	0.0	1	0.4	–	0.0	–	0.0
Myliobatidae	Eagle ray	17	0.1	1	0.4	12	0.2	1	1.5
Chondrichthyes uid	Unidentified cartilaginous fishes	3	0.0	–	0.0	2	0.0	–	0.0
Total Chondrichthyes		**48**	**0.3**	**4**	**1.7**	**26**	**0.5**	**2**	**3.1**
Belonidae	Needle fish family	1	0.0	1	0.4	–	0.0	–	0.0
Engraulidae	Anchovies	1224	6.6	24	10.2	490	8.5	9	14
Anchoa nasus	White anchovy	2	0.0	1	0.4	–	0.0	–	0.0
Engraulis ringens	Peruvian anchovy	3	0.0	2	0.8	–	0.0	–	0.0
Clupeidae	Sardines, herrings, shads	805	4.4	16	6.8	40	0.7	1	2
Galeichthys peruvianus	Sea catfish	8	0.0	4	1.7	2	0.0	1	2
Mugil cephalus	Flathead mullet	–	0.0	–	0.0	1	0.0	1	2
Trachurus murphyi	Jack mackerel	10	0.1	5	2.1	–	0.0	–	0.0
Sciaenidae	Drum/croaker family	947	5.1	7	3.0	185	3.2	1	2
Cilus gilberti	Corvina Drum	20	0.1	2	0.8	11	0.2	1	2
Cynoscion analis	Peruvian weakfish	37	0.2	22	9.3	–	0.0	–	0.0
Paralonchurus peruanus	Peruvian banded croaker	591	3.2	85	36.0	84	1.5	4	6
Sciaena deliciosa	Lorna Drum	44	0.2	21	8.9	–	0.0	–	0.0
Stellifer minor	Minor star drum	48	0.3	18	7.6	–	0.0	–	0.0
Sarda chilensis	Pacific bonito	1	0.0	1	0.4	–	0.0	–	0.0
Scomber japonicus peruanus	Pacific chub mackerel	3	0.0	1	0.4	–	0.0	–	0.0
Small Actionpterygii uid	Unidentified small bony fishes	27	0.1	–	0.0	1	0.0	–	0.0
Actinopterygii uid	Unidentified bony fishes	11,057	60.0	–	0.0	1372	23.9	–	0.0
Large Actinopterygii uid	Unidentified large bony fishes	2	0.0		0.0	2	0.0	–	0.0
Total Actinopterygii		**14,830**	**80.5**	**210**	**89.0**	**2188**	**38.2**	**18**	**28**
Sample total		**18,426**	**100.0**	**236**	**100.0**	**5734**	**100.0**	**65**	**100.0**

Bold emphasis indicates vertebrate class totals, as well as sample total

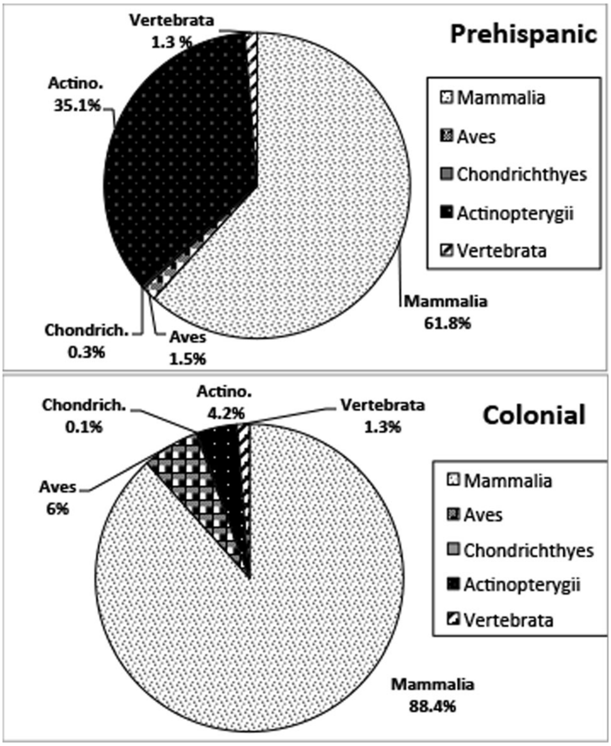

Fig. 3 Total bone weight (g) of prehispanic (*top*) and colonial (*bottom*) samples at Carrizales

In contrast, mammalian taxa account for a much greater percentage (48 %, NISP= 2,749) of the colonial period assemblage (MNI = 21, 32 %). The colonial mammal remains are also greater in their taxonomic richness, including wild species such as fox, pinnipeds (seal/sea lion), and whales. This assemblage also marks the introduction and adoption of Eurasian domestic mammals, including pigs, horse, cattle, and caprids (sheep/goats). Camelid and guinea pig remains are also present, though in very small numbers (NISP=3). Additional rodent remains are present in the colonial sample but are unlikely to have been consumed. Overall, artiodactyla/perissodactyla remains (even/odd toed ungulates, including sheep and goats, pigs, cattle, and horses/burros), as well as unidentified mammal remains, make up the largest percentage of the colonial period mammal specimens. Eurasian domesticates contribute 29 % of the total MNI for colonial period mammals (MNI = 6), highlighting the increasing importance of Old World domesticates in the local economy.

Frequencies of mammal skeletal portions from both occupations also provide limited evidence of changes in patterns of meat consumption (high quality vs. low quality meat cuts), as well as possible changes in acquisition and butchering patterns (see Fig. 4 and Table 3). Within the prehispanic sample, the majority of cuts come from the hindfoot portions of camelids, suggesting primary butchering activities on or near the site – a pattern observed elsewhere (Baxter and Hamilton-Dyer 2003). In contrast, we observe a variety of different skeletal patterns within the colonial sample. In the caprid remains,

Table 2 Age of specimens by context

		NISP			NISP		
		Prehispanic			Colonial		
Taxon	Common name	Adult	Subadult	Juvenile	Adult	Subadult	Juvenile
Cavia porcellus	Domestic guinea pig	7	1	16	2		1
Canidae	Canines				2		
Canis lupis familiaris	Domestic dog				4	2	
Lycalopex sp.	South American fox				1		
Pinnipedae	Sea lion/seal				12	1	12
Artiodactyla	Even-toed ungulates	62	1	16	9	1	30
Sus scrofa	Domestic Pig				15		3
Bovidae or Equidae	Cattle or Horse/Burro				5		
Caprinae	Sheep/Goat				27	1	33
Mammal uid	Unidentified Mammal	4		25			
Gallus gallus	Domestic Chicken				1		8
Phalacrocorax sp.	Cormorant	1					
Ciconiiformes	Ibis				1		
Aves uid	Unidentified bird	8			22		9

Specimens whose ages were indeterminable were not included

we observe high frequencies of forequarter and head portions, suggesting consumption (Stiner 1994). Pig remains show high frequencies of head, hind foot, and foot remains, also possible indicators of primary butchery. Pig's feet may also have been consumed. We must note, however, that the majority of pig remains recovered in the sample are

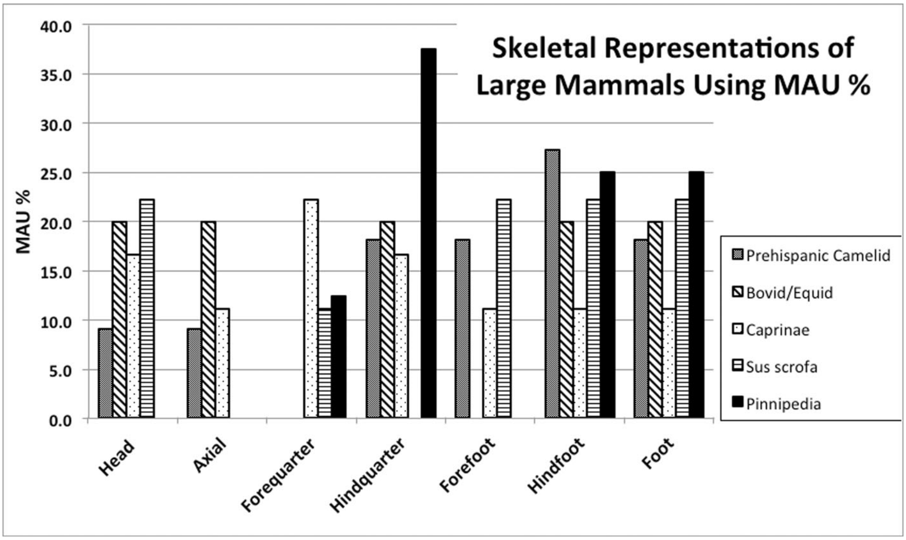

Fig. 4 Skeletal representations of large mammals using MAU %

Table 3 Frequency of skeletal parts of large mammals using minimum anatomical units (MAU)

Skeletal portion	Total NISP	MAU	% of skeletal portions
Prehispanic			
Camelid			
Head	5	1	9.1
Axial	49	1	9.1
Forequarter	0	0	0.0
Hindquarter	12	2	18.2
Forefoot	8	2	18.2
Hindfoot	14	3	27.3
Foot	26	2	18.2
Total		**11**	**100.0**
Colonial			
Bovid/Equid			
Head	4	1	20.0
Axial	4	1	20.0
Forequarter	0	0	0.0
Hindquarter	2	1	20.0
Forefoot	0	0	0.0
Hindfoot	1	1	20.0
Foot	1	1	20.0
Total		**5**	**100.0**
Caprinae			
Head	26	3	16.7
Axial	20	2	11.1
Forequarter	14	4	22.2
Hindquarter	18	3	16.7
Forefoot	8	2	11.1
Hindfoot	5	2	11.1
Foot	22	2	11.1
Total		**18**	**100.0**
Sus scrofa			
Head	7	2	22.2
Axial	0	0	0.0
Forequarter	1	1	11.1
Hindquarter	0	0	0.0
Forefoot	3	2	22.2
Hindfoot	8	2	22.2
Foot	9	2	22.2
Total		**9**	**100.0**
Pinnipedia			
Head	0	0	0.0
Axial	0	0	0.0
Forequarter	1	1	12.5
Hindquarter	7	3	37.5
Forefoot	0	0	0.0
Hindfoot	11	2	25.0
Foot	4	2	25.0
Total		**8**	**100.0**

teeth and toe elements, which have been shown to preserve better than many other elements. High frequencies of hindquarter, hindfoot, and foot portions in the pinniped remains may indicate sea-shore scavenging.

Fowl

Bird remains also diverge greatly between the two samples. In the prehispanic assemblage, they comprise one percent of all remains (NISP=267; MNI=6) and include pigeons and doves (NISP=95), cormorant (NISP=26), song birds (NISP=3), booby (NISP=1), and shearwater (NISP=1). In contrast, the colonial assemblage includes a much greater number of bird elements (NISP=764; 13 % of the total colonial period sample). Bird taxa are also more numerous in the colonial sample (11 taxa vs. 5 taxa in the prehispanic sample) and include both domesticated (chicken, goose, duck) and wild (ibis, cormorant, booby, penguin, pelican, song birds) taxa. This greater number of bird species is also reflected in an increased Shannon-Weaver diversity index (from 1.56 to 2.12) among bird taxa present in the colonial assemblage. Notably, however, identified bird remains from both the prehispanic and colonial occupations show no alteration in skeletal frequencies. In both periods, most bird meat was harvested from the chest, wings, and thighs.

Fishes

Cartilaginous fish (Chondrichthyes) elements recovered from both site sectors include shark and ray and are present in slightly higher numbers in the prehispanic sample (NISP=48) compared to the colonial sample (NISP=26). The two identified shark taxa (blue shark and hound shark) are also only found in the prehispanic sample. While differences in the MNI percentages of cartilaginous fish within the entire fish assemblage show a slightly higher percentage of individuals in the colonial sample (prehispanic=1.7 %; colonial=3.1 %), overall consumption of cartilaginous fish appears not to have changed between the prehispanic and colonial periods.

In contrast, the quantity and richness of bony fish remains (Actinopterygii) varies greatly between the prehispanic and colonial sectors. In the prehispanic sector, bony fish make up 80 % of the total sample (NISP=14,830) with 89 % of the total individual count (MNI=210). Fifteen identified taxa include anchovies, sardines, sea catfish, jack mackerel, sciaenids, corvina drum, Peruvian weakfish, Peruvian banded croaker, lorna drum, minor star drum, pacific bonito, needle fish, and pacific chub mackerel (Table 4). The most prevalent species are drums and croakers (MNI=155) and the Peruvian banded croaker is the most common individual species (MNI=85). Smaller anchovies (MNI=27) and sardines (MNI=16) also make up a large portion of the sample.

In contrast, we observe a dramatic drop in the percentage (38 % of all the remains by number, NISP=2,188) and individual count (27 % of the total individual organisms, MNI=18) of bony fish in the colonial sample vs. the prehispanic sample, as well as a drop in bony fish species richness, with only seven taxa identified and a corresponding drop in Shannon-Weaver diversity of 1.9 to 1.48. The most abundant species from the prehispanic period (Peruvian banded croaker, anchovies and sardines) are also present in the colonial period, but anchovies (MNI=9) dominate the colonial sample, followed by the Peruvian banded croaker (MNI=4) and sardines (MNI=1).

Table 4 Bony and cartilaginous fish presence at Carrizales

Species name	Common name	Prehispanic	Colonial
Carcharhinus sp.	Carcharhinus shark	✓	✓
Prionace glauca	Blue Shark	✓	
Mustelus sp.	Hound Shark	✓	
Myliobatidae	Eagle Ray	✓	✓
Belonidae	Needle Fish	✓	
Engraulidae	Anchovies	✓	✓
Anchoa nasus	White Anchovy	✓	
Engraulis ringens	Peruvian Anchovy	✓	
Clupeidae	Sardines/Herrings/Shads	✓	✓
Galeichthys peruvianus	Sea Catfish	✓	✓
Mugil cephalus	Flathead Mullet		✓
Trachurus murphyi	Jack Mackerel	✓	
Sciaenidae	Drums/Croakers	✓	✓
Cilus gilberti	Corvina Drum	✓	✓
Cynoscion analis	Peruvian Weakfish	✓	
Paralonchurus peruanus	Peruvian Banded Croaker	✓	✓
Sciaena deliciosa	Lorna Drum	✓	
Stellifer minor	Minor Star Drum	✓	
Sarda chilensis	Pacific Bonito	✓	
Scomber japonicus peruanus	Pacific Chub Mackerel	✓	

Analysis also reveals some differences in the distribution of habitats from which marine specimens in the two occupations derive (Fig. 5). Following Béarez (2012), we identify four separate marine habitats: sandy coastal bottoms, the neritic pelagic zone, the coastal benthopelagic zone, and the ocean pelagic zone. Drums and croakers (*Sciaena deliciosa, Paralonchurus peruanus, Cynoscion analis, Cilus gilbert*) dominate the sandy coastal bottom marine habitat. The neritic pelagic zone fishes include anchovies and sardines, as well as Pacific bonito and Pacific chub mackerel. Hound shark and eagle ray inhabit the coastal benthopelgaic zone, and carcharhinus shark and blue shark are found in the ocean pelagic zone. Within the colonial assemblage, there are fewer elements from species that derive from the oceanic pelagic zone, in deep waters beyond the continental shelf. There are also fewer elements from species from sandy bottom areas. Instead, we observe an increase in the percentage of fish common in the neritic pelagic zone, areas found closer to shore (an increase of 21 % to 50 %, using MNI).

It is worth noting that taphonomic factors likely hold some implications for species representation in the Carrizales assemblages. Previous research suggests that the remains of drum, croakers, and catfish preserve better than other species (Béarez 2012). Additionally, hyperostosis, a pathological condition that leads to swelling or enlargement of thin bones, may also lead to preferential preservation (Béarez 1997, 2012). We observed hyperostosis in 1,394 fish remains at Carrizales (8 % of the total

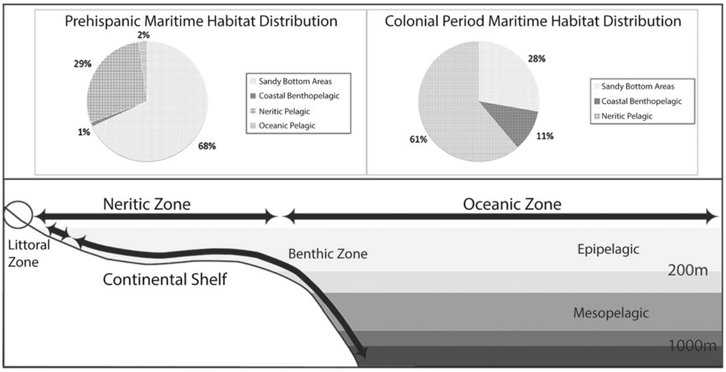

Fig. 5 Habitats occupied by fish specimens recovered form excavations at Conjuntos 125/131 (Late Sicán Period) and Conjunto123 (Colonial period)

bony fish sample), with most cases occurring in Peruvian banded croakers. Finally, we recorded a larger number of diagnostic elements for drum and croaker fishes than other species. Therefore, the Peruvian banded croaker, drums and croakers, and catfish identified in the assemblage may be overrepresented in comparison to other fish species. However, no differences in preservation conditions exist between Conjuntos 123 and 125/131, and therefore these taphonomic factors should have no effects on inter-assemblage comparisons.

Commensal Animals

Reptile remains present in both the prehispanic and colonial samples were identified to order (Squamata) or suborder (Lacertilia) and include snake and lizard vertebrae. Prehispanic remains include snake (NISP=40) and lizard (NISP=1) elements, whereas only snake (NISP=7) remains were recovered from the colonial sector. The remains account for less than one percent of each assemblage and were most likely not consumed due to their small size. Small reptiles are abundant in dry, coastal areas and these remains may have been commensal animals or recent animals trapped in excavated fill.

Bone Modifications

Across both the prehispanic and colonial period assemblages, we recorded several varieties of bone modifications – evidence of butchering, burning, and close contact with iron (oxidation). Prehispanic butchery evidence is rare (NISP=15), with bird and mammal specimens displaying infrequent small cut marks on the breast or back, and marks associated with secondary processing and/or consumption. Evidence of butchering is much higher in the colonial assemblage, with both mammal (NISP=86) and bird (NISP=36) remains displaying evidence of butchery. More varied butchery practices are also evident: hacks and sawing (NISP=28), indicating primary butchery (initial butchery and separation of carcass), and cutting (NISP=94), associated with secondary processing and/or consumption. Alongside the greater percentage of foot elements (metapodials, phalanges) in the colonial sample, increased evidence of hacks, saws, and cuts suggest that the colonial residents of Carrizales carried out on-site processing of a greater percentage of the large, terrestrial mammals and birds that they consumed than their Late Sicán period forebears.

Numerous bones in both samples also display evidence of burning. Prehispanic burned remains include both mammal and fish species and account for one percent of the assemblage. In contrast, burned remains from the colonial assemblage include a greater variety of taxa (mammals, birds, shark, and fish) and account for a higher percentage (8 %) of the sample. This increase in burned bones may suggest a change in food processing and culinary behavior, such as an increased focus on cooking over an open flame, during colonial times. However, to determine whether bone was burned during cooking, or whether burning occurred at a later time for disposal, a more detailed analysis of internal bone structure would be needed (see Hanson and Cain 2007).

Finally, two colonial specimens exhibit signs of rust, suggesting that they were in close contact with iron in the depositional environment. Iron, a novel material among tools used in the colonial period, may have been used in Colonial Period butchery.

Discussion

Our analysis reveals notable differences in materials recovered from the Late Sicán (Conjunto 125) and early colonial *reducción* (Conjunto 123) sectors of Carrizales. Conditions for preservation are nearly identical in each of these areas: both are located on low rises in a windswept landscape, above depressions seasonally filled with brackish water. Their stratigraphy is shallow, and their lowest levels are located no more than 50 cm below the surface. Architecture within both site sectors seems to have consisted of wattle-and-daub structures, and waste was deposited in middens located nearby living areas. We therefore interpret observed differences in species richness and diversity within both sites as indices of dramatic changes in subsistence activities between the Late Sicán and Early Colonial periods. Remains from the prehispanic sector reflect a domestic economy based largely on marine fishing, supplemented occasionally by the hunting of wild animals (deer, cormorant, and booby) and the husbandry of a small number of Andean domesticates (camelids and guinea pigs). After Spanish contact and forced resettlement, there appears to have been a notable decrease in the intensity and diversity of fishing activities and an increase in the hunting of birds and the exploitation of desert-adapted Old World domesticates (Table 5). In our view, understanding these trends requires appreciation of several overlapping sources of social change in colonial society: 1) the introduction of new technologies and animal species following Spanish colonization; 2) changes in tributary obligations and political subjectivity, themselves linked to the growth of local markets and connections with distant places; and 3) regional and local demographic decline.

The introduction of iron cutting implements appears to have had a modest impact on how the residents of Carrizales processed their foods, with rust on several bones indicating that iron tools were likely used in the colonial *reducción*. No iron production facilities have been identified either through excavations or geophysical survey at the site, therefore suggesting that such implements were obtained through trade. However, the dimensions of cuts on bones remain similar across the prehispanic and colonial

Table 5 Domestic animal presence at Carrizales

Species name	Common name	Prehispanic	Colonial
Cavia porcellus	Guinea Pig	✓	✓
Canis lupis familiaris	Domestic Dog		✓
Equidae	Horse or Burro		✓
Sus scrofa	Domestic Pig		✓
Camelidae	Camelids	✓	✓
Bos taurus	Domestic Cattle		✓
Caprinae	Sheep or Goats		✓
Galliformes	Chicken Order		✓
Gallus gallus	Domestic Chicken		✓
Anseriformes	Ducks or Geese		✓
Anser anser	Domestic Goose		✓
Cairina moschata	Muscovy Duck		✓

samples, and we see little to suggest wholesale changes in the technologies used for meat processing. Additional evidence collected from both site sectors suggests that fishing activities were also carried out using relatively similar technologies during the Late Sicán period and the late sixteenth century. Several patterns point to the dominance of net fishing during both eras, with little use of adapted hooks or lures. Fishing weights of the kind used for weighing down nets (Hammel and Haase 1962) are common at both sites.

The estimated fish sizes and ages based on otolith measurements are broad (VanValkenburgh et al. nd) – a pattern consistent with net fishing, which leads to larger fish being trapped and smaller fish swimming out of the netting. Yet large numbers of anchovies and sardines – species typically fished using nets and weights – are also found in both samples. These findings suggest the use of at least two different sizes of nets, ones with larger openings and ones with smaller openings, were employed during both occupations. Changes in marine species richness and diversity across the samples must therefore be explained as the results of shifts not in technology or processing so much as in collection behaviors, including differences in how Carrizales's residents allocated their time and targeted fishing zones.

The introduction of Eurasian domesticated animals seems to have had a notable impact on local subsistence practices, and Eurasian domesticates quickly became important staples for Carrizales's residents. Many of the new animals found in abundance in the colonial occupation – chicken, sheep/goats, and geese – are all relatively small to medium sized animals that would have been well suited for life on Peru's dry, northern coast. Indeed, deFrance (2003) suggests that these animals are arguably better adapted to arid conditions than Andean domesticates, whose wild forebears are native to wetter highland regions.

In more humid colonized regions of the Americas, such as Central America, Florida, and the Caribbean, archaeologists working on indigenous sites dating to the sixteenth and seventeenth centuries have found that local populations often did not incorporate Eurasian domesticates so quickly into their foodways (Deagan 1988; deFrance and Hanson 2008; Pavao-Zuckerman 2010; Reitz 1990, 1992; Spielmann et al. 2009). There, tropical climates appear to have led to high mortality rates among introduced domestic animals (Reitz and Scarry 1985), and foodways continued to focus primarily on local fauna, with small numbers of introduced Eurasian domesticates serving as exotic supplements (deFrance and Hanson 2008).

In the Andes, archaeologists have identified several cases in which Old World domesticates were central to colonial period foodways. At highland *bodega* (winery) sites in the Moquegua valley of southern Peru and in peninsular households in the settlement of Tarapaya, outside the city of Potosí (deFrance 2003), people of Spanish descent consumed a diet with a very high proportion of Old World domesticates, potentially signaling the importance of food practices as sources of ethnic distinction in these two communities. At Torata Alta, a highland *reducción* nearby the Moquegua bodegas, deFrance (1996) found that indigenous residents consumed small amounts of pigs, sheep, goats, chickens and doves in the late sixteenth century, but that these animals constituted no more than 5 % of the total colonial period faunal assemblage, and faunal remains continued to be dominated by camelids and guinea pigs.

In light of this comparative overview of the adoption and use of Old World domesticates in colonial contexts, the high percentage of identified Eurasian domesticates (26 %, MNI=17) in the colonial section of Carrizales is truly striking. Carrizales was certainly well situated for sheep and goat pastoralism as it is located within a hydrological marginal area of an already arid environment, but relatively nearby stands of algarrobo (*Prosopis*) forest would have provided abundant fodder for sheep and goats. However, deeper inquiry into local social conditions is required to understand why the residents of Carrizales rapidly adopted Old World fauna.

Regional population loss and economic change were two interrelated factors that created unique social challenges at Carrizales. While indigenous groups in the southern Peruvian highlands also experienced demographic decline in the sixteenth and seventeenth centuries, losses were particularly acute in the Zaña/Chamán region, as outlined above. Collectively, population loss would have had major effects on subsistence practices, greatly decreasing the total labor pool available for food collection and preparation and also affecting the transmission of fishing and foraging knowledge.

The demonstrated drop in marine species diversity and shifts in habitat distribution among collected marine species between the Late Sicán and colonial occupations suggest increasing concentration on less time-intensive modes of fishing during the late sixteenth century. The decrease in oceanic pelagic species and the increased frequency of neritic pelagic fish species among the colonial sample demonstrate that colonial populations collected fewer fish farther away from shore – a pattern also apparent among the mollusk data, which show a drastic drop in diversity and an increased emphasis on near-shore collecting during the colonial period (VanValkenburgh et al. nd). The decrease in marine faunal abundance and diversity during the Colonial Period may also indicate an overall loss of fishing knowledge. Comparative studies of American indigenous populations suggest that epidemics are particularly harsh on the old and the young (Hill and Hurtado 1996, pp. 188–194), and the death of elderly individuals would have seriously compromised artisanal knowledge of such practices as constructing fishing nets and reed fishing boats, as well as knowledge of propitious fishing grounds and related weather and water conditions.

The presence of pinnipeds and whales in the colonial sample may also indicate an increase in shoreline scavenging activities. Historical records from the Early Colonial Period on the North Coast provide evidence that indigenous populations did scavenge beaches for whale remains, which are rich in oil and blubber (Flores Galindo 1981, pp. 159–65; Santillán et al. 2004). However, there is little evidence of extensive whale and sea lion hunting in prehispanic times. To date, excavations at Carrizales have not recovered evidence of deep-sea, pinniped hunting technology (e.g., harpoons), suggesting that these mammals were not actively hunted. Additionally, recovered pinniped elements appear to correspond to juvenile individuals, perhaps indicating stranded juvenile animals that washed ashore from distant rookeries (Etnier 2002). In the context of declining labor availability, shoreline scavenging would have provided valuable nutrition that required much less time and specialized knowledge to collect than pelagic fishes.

In addition to dealing with declining labor availability due to population loss, the colonial residents of Carrizales also faced subsistence challenges due to changes in their tributary regimes. As we note above, Chérrepe's arrears from 1564 indicate that their *encomendero*, who relied on them for both subsistence and profit, required them to produce 14 different forms of tribute, including cloth, wheat, fowl, eggs, salted fish, pigs, and *algarrobo* wood, as well as to provide labor for farming and herding tasks (AGI Patronato 97A R.4 15-17v; Ramírez 1996, p. 106). While these records predate the foundation of the *reducción* at Carrizales by between three and eight years, they provide an image of the types of external economic pressures that tributary demands exerted on the local population – extending the *range* of goods that locals were expected to produce.

In short, the presence of pigs, caprids, and increased numbers of fowl in the faunal assemblage from the colonial sector may reflect the community's efforts to fulfill its tributary obligations, and age profiles reconstructed from the recovered remains offer some clues about how they balanced between the needs of local consumption and tributary production. For example, the high percentage of juvenile remains among caprids and pigs from the colonial assemblage suggests that residents were raising the animals locally, instead of trading for prime-aged animals. Cut marks recorded on pig, caprid, and bird bones suggest that Carrizales residents were also consuming a portion of these animals on-site, although the relative absence of sub-adult individuals suggests that younger animals with more tender meat may have been given away as tribute. The presence of older terrestrial mammals at Carrizales also indicates that a portion of the Eurasian domesticates raised near the site were allowed to reach old age, and were perhaps used as sources of secondary products and services such as fiber/wool, milk, and waste removal (pigs) (deFrance 2010). The conservation of older animals for their secondary production (fiber, labor, transport, dung for fuel) would have had to been weighed against external demands to render younger animals as tribute.

Tributary demands of cloth, cotton, wheat, wood, and labor (in the form of *mita* and shepherds) would have also impacted local foodways. Preliminary botanical analysis indicates that greater amounts of cotton and *algarrobo* seeds are present in colonial middens than in the Late Sicán sample – albeit no wheat, underscoring the fact that not all products demanded for tribute were incorporated into indigenous foodways (Hassler 2014; VanValkenburgh et al. nd). In all, whether the residents of Carrizales produced these products themselves or traded for them, demand for tribute in botanical products would have further reduced time available for pursuing fishing and hunting. Under these circumstances, incorporating Eurasian animals into their diets – animals that they were already being compelled to rear by their tributary obligations – would have reduced the overall labor burden of daily subsistence.

Here, comparison with foodways at the southern highland *reducción* of Torata Alta, which is among a relatively few Andean colonial period sites where systematic research on foodways has been conducted, is productive for understanding the unique challenges that Carrizales's residents faced under Spanish rule. While the inhabitants at highland Torata Alta were also under similar tributary obligations to those at coastal Chérrepe, much of the local demand at Torata Alta centered on camelid meat and wool (Van Buren 1993). From early on in their colonization of the continent, Spanish officials deemed the Peruvian coast a poor environment for herding and camelid production, and later used geographical observations published in the *Relaciones Geográficas* (descriptions of American climates and places) in 1571 to orient tributary regimes (Orlove 1993). The highland areas of Peru were deemed better for herding and cloth production, which seems to have led to less radical disruption of local subsistence practices during colonial rule.

In addition to geographic differences related to tribute demands, demographic decline in the upper Moquegua valley appears to have been far less aggravated than in the Zaña and Chamán valleys (Cook 1981). Accordingly, the colonial period faunal assemblage from Torata Alta reflects a relatively conservative subsistence strategy, with the vast majority of remains corresponding to camelids (deFrance 1996; Van Buren 1993). With a more robust population and less challenging tributary obligations than the inhabitants of Carrizales, they retained the ability to pursue traditional subsistence strategies and avoided radically altering the rhythms of their daily lives in order to survive under a new political regime.

Conclusions

Food remains from Carrizales outline substantial differences in subsistence and food procurement between the Early Colonial and Late Sicán Periods. In the late sixteenth century, Carrizales's residents focused their fishing on a smaller subset of marine species. The residents spent less time and labor fishing and instead scavenged the shoreline for marine mammal remains. In addition, they placed new emphasis on terrestrial food resources, including Eurasian domesticated animals such as sheep/goats, pigs, chickens, and geese.

We interpret these changes as local responses to colonial social and political challenges. Faced with demographic collapse, forced resettlement, and new labor and tribute demands, Carrizales's residents pursued less time intensive strategies of food procurement in a context of declining labor availability. Fishing closer to shore and scavenging for marine mammals saved valuable time, while investment in raising Eurasian domesticated animals, which offered some biological advantages over Andean domesticates, allowed them to simultaneously feed themselves and meet tributary demands. While they made radical adjustments to their subsistence strategies in order to survive, similarities in cut marks suggest that they also maintained some culinary traditions.

Recent scholarship on the effects of the Spanish invasion of the Americas has sought to counter so-called quencentennial or "all or nothing" models of conquest (Smith 2003), which imagine 1492 (and in the case of western South America, 1532) as moments of complete rupture, failing to recognize transconquest continuities in social institutions and cultural practices (e.g., Clendinnen 2003; Farriss 1984; Wernke 2007a, 2007b). One element of this corrective approach has been to emphasize the indirectness of Spanish imperial control, particularly during early colonial times – including attempts to preserve (if not also sediment) indigenous political hierarchies and missionary efforts to translate Christian concepts into local categories (Durston 2007; Gose 2003, 2008; Mumford 2012). However, the social experience of native people at Carrizales, as within the North Coast region more broadly, underscores how disruptive Spanish colonization was for some regions and households – often despite imperial attempts to leave local institutions intact. In particular, population loss due to introduced diseases and the appropriateness of coastal Peruvian climates for producing a wide range of Eurasian foodstuffs led to unanticipated consequences for native households. Their survival and adaptation in the face of such challenges is a demonstration of their extraordinary resilience.

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Archival Abbreviations *AGI – Archivo General de Indias, Seville, Spain*

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