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# Dynamics of Indigenous Demographic Fluctuations

## Lessons from Sixteenth-Century Cusco, Peru

by R. Alan Covey, Geoff Childs, and Rebecca Kippen

Reconstruction of the local impacts of imperial expansion is often hindered by insufficiently detailed indigenous demographic data. In the case of Spanish expansion in the Americas, native population declines are widely observed, but underlying dynamics are still incompletely understood. This paper uses a 1569 survey of more than 800 nontributary indigenous households in the Yucay Valley (highland Peru) to investigate demographic changes occurring during the Spanish transformation of the Inka imperial heartland. A suite of demographic analyses reveals that while the study population experienced significant demographic stresses, fertility rates recovered to levels that would lead to population growth in the long term. These new perspectives on indigenous fertility indicate that some rural Andean populations successfully adapted to new imperial arrangements. Long-term demographic declines in the Yucay Valley and surrounding region may thus be attributed to recurring disasters (especially epidemic disease) and an insatiable colonial administration that was not sufficiently flexible or sensitive to dynamics of demographic flux.

*Take up the White Man's burden— / The savage wars of peace— / Fill full the mouth of Famine / And bid the sickness cease* (Rudyard Kipling 1922 [1899])

Expanding empires have often justified territorial annexation and colonial administration in ideological terms, touting the salubrious effects of bringing civilization, salvation, and security to the benighted margins of their worlds. Rather than alleviating native conditions of internal warfare, pestilence, and famine, the intrusion and policies of colonial empires frequently introduced or intensified them, with devastating consequences for millions of rural farmers and herders living in colonized regions. The dynamics and intensity of imperial disruption are complex, depending on local social and environmental conditions, the ideologies and policies of expanding states, and the degree of resistance to diseases spread by colonists and their domesticated animals. The human toll,

typically measured as an absolute decline in indigenous population over a span of generations or centuries, is often treated as the dark synecdoche of empire's inherent excesses. Core-periphery formulations may influence how interpretations of these processes unfold, with indigenous population serving as a dependent variable on which imperialism acts.

Understanding the deleterious effects of empire on colonized peoples requires not only the detailed description and contextualization of imperial expansion and administration but also a more nuanced demographic perspective where fertility, mortality, and migration can be evaluated (cf. Peterson 1975). Without detailed accounts of indigenous historical demography, imperial effects remain ambiguous and one-sided—a debate over just how deadly an empire's early military practices, administrative policies, and diseases really were, from the perspective of imperial representatives and their critics. Unfortunately, empires typically took considerable time to develop administrative institutions that could track indigenous demography and address regional food supply, health, and civil order. The concern for officials, soldiers, and colonists from the center was generally not matched by a corresponding preoccupation for conquered local populations. When official population counts were made, they tended to reflect the imperial focus on tribute in coin, kind, or labor—empires have often collected official counts of male householders for taxation and conscription purposes, and the failure to count women and children and register affiliated

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households prevents researchers from reconstructing key aspects of demographic change.

This paper considers dynamics of indigenous population decline in the Cusco region, the heartland of the Inka empire, during the decades following the Spanish conquest. Working with household surveys from a nontributary population living in the Yucay Valley in 1569, we present an analysis of fertility and, to a more limited degree, migration and mortality. The degree of detail and size of this early database permits us to identify ways that Andean populations adapted to new colonial conditions, as well as the contribution of epidemic disease, administrative mismanagement, and macrodemographic fluctuations to long-term processes of indigenous population decline.

## Indigenous Depopulation in the Spanish Americas

Spain's colonial trajectory in the Americas began earlier than that of other European empires, covered a broader geographic extent, and focused more intensively on bringing indigenous populations under formal administration. The ostensible goal of Spanish expansion—pacifying the hemisphere to bring Christianity to its peoples—stimulated vigorous debates on the temporal practicalities underlying Spain's spiritual mission. Soon after Spaniards settled on Hispaniola, they began to describe losses to the indigenous Taíno population. In 1511, a Dominican friar named Antonio de Montesinos delivered a sermon to Spaniards in Santo Domingo, denouncing the practices that were destroying the Taínos:

With what right and what justice do you hold those Indians in such cruel and horrible servitude? With what authority have you made such detestable war on these peoples, who were in their calm and peaceful lands; where [their population being] so limitless, you have consumed [it] with unheard of deaths and ruination? How can you keep them so oppressed and fatigued, without feeding them or curing their sicknesses, which they incur from the excessive labors that you give them, and to which they succumb?<sup>1</sup>

As Spain continued to make new conquests and establish a more formal colonial government, many clergy in the Indies vigorously opposed the growing empire (Hanke 2002). This internal critique influenced administrative policies, but one unintended consequence was the promulgation of the “Black Legend”—a portrayal of the Spanish empire that dominated

the English literature until well into the twentieth century and placed the blame for most native deaths on conquistador cruelty and rapacious Spanish imperial institutions (cf. Cook 1998:1–7; Lovell 1992:427).

The Black Legend was crafted using anecdotal evidence and fashioned to meet ideological purposes of priests and imperial rivals of Spain. In the past century, scholars have sought hard evidence to evaluate early accounts of indigenous population decline in Spain's American territories (e.g., Cook 2002*b*; Livi-Bacci 2003; Martí Carvajal 2002). This has included the longitudinal study of population records to assess the scale of population loss and the factors underlying local processes. Evaluating the magnitude of indigenous population loss in a given region almost always involves a backward calculation of contact-era population levels, using census data from later periods. Latin American contact figures are generally projected from late-sixteenth- or early-seventeenth-century administrative documents, and in many regions the earliest reliable population counts occurred decades after the conquest and were limited to aggregate figures for a few age and gender categories (cf. Cook 1981; Lovell and Lutz 1995; Newson 2003; Whitmore 1992). More detailed administrative surveys and parish records provide valuable perspectives on community and household organization, but their small sample sizes and inconsistent or fragmentary data preclude intensive demographic analysis (for the Andes, see Cook 1981; Hadden 1967; Ramírez-Horton 1978). Even where indigenous states preserved some accounting of precontact records—for example, in the Basin of Mexico and central Andes—contact population estimates vary widely, and scholarly debate has focused more on which calculations are most plausible rather than the demographic dynamics at play in the first generations of colonial transformation (cf. Denevan 1992; Henige 1998).

Early critics of Spanish expansion blamed warfare for reducing indigenous populations and described exploitative tribute demands as weakening and sickening native laborers so that they were more likely to die. More recent research has shifted from policies to plagues, highlighting the effects of “virgin soil” epidemics where European diseases decimated Amerindian populations lacking resistance (Crosby 1976; Jones 2003; see also Cook and Lovell 1991; Dobyns 1993). Disease-based reconstructions combine written accounts of pandemics with periodic aggregate population counts taken from other sources. In the absence of detailed demographic evidence, a correlation between high mortality, low fertility, and disruptive migration patterns is often assumed (Thornton 1997). Focusing on disease may also deemphasize other factors influencing mortality, such as warfare, food insecurity, and disruptive administrative practices (Joralemon 1982). Researchers are aware that disease is itself insufficient for explaining depopulation, but extraordinary documentation is required to develop empirical perspectives of the context and demographic factors involved. This paper uses a remarkable set of household-level data recorded in the Cusco region of highland Peru to explore critical demographic processes that

1. Translation by R. A. Covey. “¿con qué derecho y con qué justicia teneis en tan cruel y horrible servidumbre aquestos indios? ¿Con qué autoridad habeis hecho tan detestables guerras á estas gentes que estaban en sus tierras mansas y pacíficas, donde tan infinitas dellas, con muertes y extragos nunca oídos, habeis consumido? ¿Como los teneis tan opresos y fatigados, sin dalles de comer ni curallos en sus enfermades, que de los excesivos trabajos que les dáis incurren y se os mueren, y por mejor decir los matais, por sacar y adquirir oro cada día?” (quoted in las Casas 1875 [1552–1562], bk. 3, chap. 4).

are difficult to document in the more coarse-grained data available for other parts of the early Colonial Period Americas.

## Imperial Transitions in the Inka Heartland

Recently published archival documents (Covey and Amado González 2008a) chronicle the early Colonial Period household organization and tributary service of an indigenous retainer population settled in four communities in the Yucay Valley, located near Cusco, the Inka capital (fig. 1). The Cusco region underwent a radical transformation during the fifteenth and early sixteenth centuries, as the Inkas consolidated their dominion over previously autonomous neighbors and developed the area around their capital as the heartland of the largest indigenous state in the Americas (Covey 2006). Royal lineages invested labor tribute in fertile valley-bottom areas to develop highly productive estates that were worked by a sizeable servant population (*yanakuna*, sing. *yana*). Local Inka communities also possessed resources for farming and herding, but many groups were required to send parts of their

populations to colonize provincial regions. The first decades of the sixteenth century saw Cusco emerge as a densely populated and cosmopolitan region that was largely untouched by the military violence seen in frontier regions and resistant provinces. Massive food surpluses were collected around the capital, a bounty that buffered the region against famines caused in provincial regions by climatic variations (and probably in some cases by Inka imperial policies). When the European invasion of the Inka realm began in earnest in 1532, much of the population of the Cusco region comprised *yanakuna* and individuals in other special statuses who were brought from provincial regions and placed in the service of the nobility and state institutions.

The transition to Spanish rule was particularly bloody in the Inka heartland. An Inka civil war in the advent of the Spanish advance gave way to native uprisings, factional infighting, and Spanish rebellions against the royal authority (for a review of this period, see Hemming 1970). The first Spaniards settling in Cusco attempted to establish estates comprising *yanakuna* and Inka populations living in the region—the best native labor grants (*encomiendas*) tended to

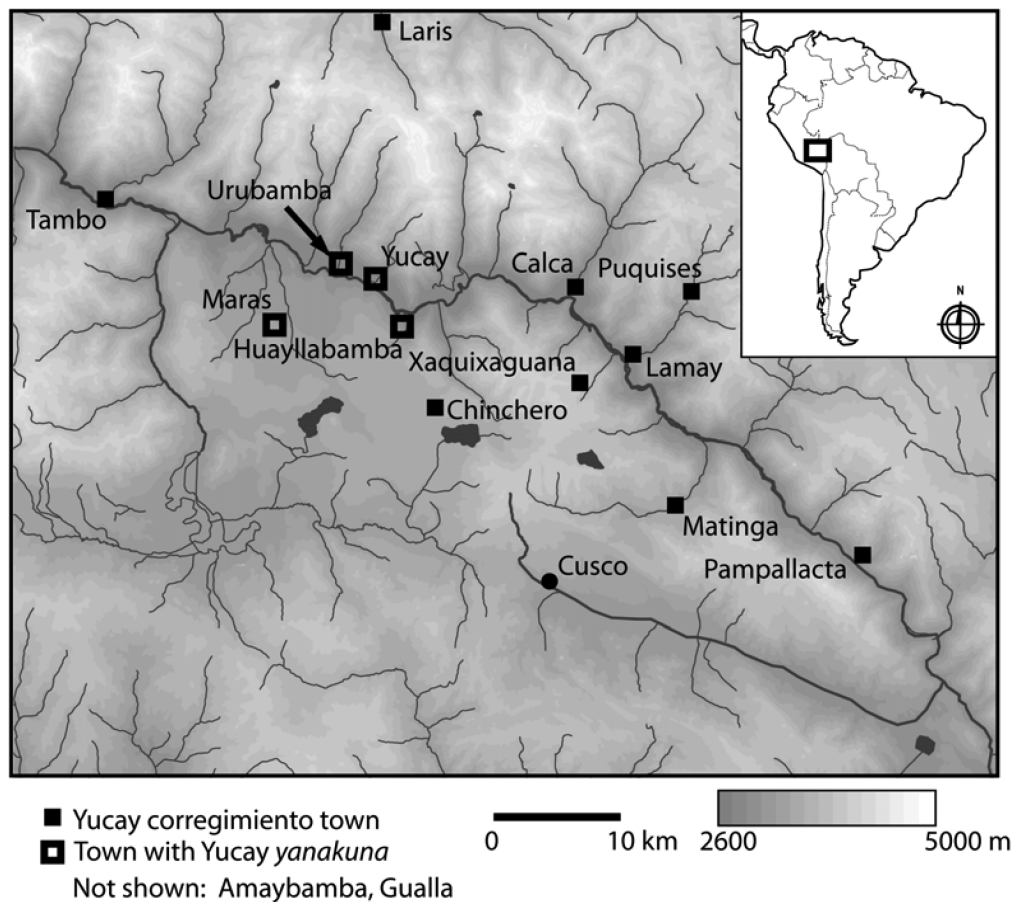


Figure 1. Map of the Cusco region, showing selected indigenous *repar-timientos* in the province of Yucay.

have workers who had served the Inka nobility, as they were the ones with access to the best productive resources (e.g., Varón Gabai 1997). The Yucay Valley represents one such case. Francisco Pizarro took the indigenous population of the valley as his *encomienda* in the late 1530s, but those serving him continued to do so following Inka estate practices, which included personal services (Covey and Elson 2007; Covey and Amado González 2008a).

As Spain articulated a clearer sense of its imperial mission, colonial administrators began to impose more uniform policies, particularly from the 1550s and afterward. Although Crown officials made some early attempts to levy tribute and collect population data, it was not until the tenure of Francisco de Toledo, the fifth viceroy (1569–1581) that systematic tribute assessments for the indigenous population were made across Peru (Cook 1975; Rostworowski de Diez Canseco 1983–1984). Surviving Toledan counts are limited to a few basic gender and age distinctions at the level of the tributary grant (*repartimiento*). These were carried out in conjunction with a resettlement program aimed at reducing dispersed indigenous villages and hamlets into Spanish-style towns for more effective administration. After Toledo's general census, new tribute assessments (*tasas*) were not carried out uniformly or regularly, and there are discrepancies that make longitudinal comparisons problematic, especially for assessing population change over time (see Cook 1982b).

For example, the Toledan documents (1571–1575) for the province of Yucay list 4,052 tributary males and a population of approximately 20,000 (Cook 1982b). In 1583, the viceroy Martín Enríquez (1921 [1583]:166–167) listed 4,205 tributaries in a total population of 20,625. The latter figures include several tribute grants (*repartimientos*) not in the Toledan records, and they omit many of the earlier ones. Of the *repartimientos* that are listed in both sets of records, Toledan counts are preserved for several entries (suggesting that new counts had not been made), but there is an increase of 177 tributaries and a net increase of total population of 460 (table 1). Despite inconsistencies in longitudinal data, the following discussion will demonstrate that population growth occurred in some *repartimientos* at certain times, despite a long-term trajectory of demographic collapse.

It should be noted that not all changes in the numbers of indigenous tributaries are attributable to real population fluctuations. Other possible reasons that figures might change include (1) the legal exemption of certain individuals from tribute, (2) the flight of individuals from tributary communities, and (3) inaccuracies and fraudulent manipulation of census activities or archived documents.

### 1569 Household Data from the Yucay *Yanakuna*

The data presented in this paper represent a case where a population claiming tributary exemption was reassigned to tributary status, leading to a lengthy legal proceeding (Covey

Table 1. Counts of tributaries and total population in documents from Toledo (1570s) and Enríquez (1583) in the province of Yucay

<i>Repartimiento</i>	Male tribute payers		Total population	
	Toledo	Enríquez	Toledo	Enríquez
Yucay	708	708	3,433	3,433
Maras	240	240	1,262	1,262
Laris	242	332	1,242	1,625
Calca	612	612	3,344	3,134
Pampallacta	251	290	1,279	1,492
Amaybamba	91	127	372	549
Tambo	209	219	919	918
Chinchero/Cupirpongo	274	274	1,350	1,342
Xaquixaguana (Coya)	366	366	2,044	2,044
Gualla	190	192	614	620

and Amado González 2008a). In contrast to *tasa* counts of tributaries, our data set originates in parish records, a notebook of household visits collected by a local priest, Diego Escudero, who arrived in the Yucay Valley in the late 1560s. The valley had come under the administration of royal authorities in 1548, and Escudero was sent as parish priest to the natives living there. Within a few months of his arrival, Escudero assembled local leaders and collected information on the tributary population of the valley, as well as the population said to be *yanakuna*, personal retainers of local elites, Inka nobles, and Spaniards, who were exempt from tributary service. Some of the *yanakuna* served Inka nobles—including descendants of the emperor Huayna Capac, who had established personal lands and servants in the valley in the late fifteenth century—while others were settled on garden plots and orchards granted to their Spanish masters by the Cusco town council (for a discussion of *yanakuna* in another part of the early Colonial Andes, see Powers 1995). In 1569, Escudero tabulated information on the tributary and *yana* populations of the valley in separate books (Covey and Amado González 2008a [1574: fol. 91ff.]; see Villanueva Urteaga 1970).

Two years later, Pedro Gutiérrez Flores, a friar appointed by the viceroy Francisco de Toledo, arrived in the valley with the task of visiting the indigenous communities of the Cusco region (Covey and Amado González 2008a [1577–1578: fol. 421–424v]). Using Escudero's book but allegedly without consulting the viceroy or the indigenous leaders in the valley, Gutiérrez Flores reduced the *yanakuna* into four towns along with tributary populations already settled there. In the process, Gutiérrez Flores created a table of more than 800 *yana* households, including the names and ages of adults and their children, as well as the services, lands, and payments made by each household (Covey and Elson 2007; Covey and Amado González 2008a).

The reduction of the Yucay Valley *yanakuna*—which resulted in many of them being taken from the tributary population and into Crown service—led to a lawsuit by Beatriz

Clara Coya (an Inka descendant of Huayna Capac) and her husband, Martín García de Loyola, who inherited the grant of the tributary population of the valley (see Covey 2008; Covey and Elson 2007). The household survey became part of the overall documentation of a lengthy series of legal proceedings (Covey and Amado González 2008b).

The context and form of the household survey of the Yucay Valley *yanakuna* stand apart from contemporary documents in several significant ways. Data were collected before populations were reduced into Spanish-style towns, and they were reaffirmed by a royal official 2 years later, allowing for emendations. The initial survey was conducted by a resident of the valley, with the cooperation of local elites, reducing the likelihood of demographic fraud, which is alleged to have happened during many short inspections of local communities, including during earlier administrative visits to the Yucay Valley (Covey and Amado González 2008a [1573–1574: fol. 91; 1577: fol. 250v]; Villanueva Urteaga 1970). Furthermore, unlike contemporary tribute levies (*tasas*)—including those conducted in other places by Pedro Gutiérrez Flores, the official who copied Escudero’s data and ratified them—the household survey gives ages for all men, women, and children and places them into family units affiliating parents and children. As a result, the household survey is amenable to far more detailed demographic analysis than other population data sets from this region and time period.

Counterbalancing these advantages, we are faced with the question of whether a collection of *yana* households can be considered a demographic unit and whether the characteristics of the Yucay Valley sample may be considered representative of tributary populations in the Cusco region during the Toledan era. Although the *yanakuna* were reduced into four towns with tributary populations, they represented households serving specific masters, with at least 70 different men and women having retainers listed in the household survey (Covey and Elson 2007:313–315). Because household data are recorded consistently and unaffiliated individuals (widows, orphans) are included in the survey, the data set may be used to assess reproduction patterns, which is not possible to do using contemporary census data from the Toledan tribute levies.

The question of compatibility of the overall sample with other native population units—*encomienda* or *repartimiento* designations, which cut across native communities and Spanish reduction towns—is best evaluated by considering how the Yucay sample compares with the broader categories recorded for tributaries in the Cusco region in the early 1570s. Cook (1982b; see also Cook 1975) has published data from 24 tributary units (*repartimientos*) from the *corregimiento* of Yucay in the early 1570s. These units show considerable variation in total population size (from 39 to 3,433), reflecting the fact that *repartimientos* did not correspond to community boundaries. Some comprise multiple postreduction communities, while others represent a single Colonial Period town. The smallest units represent descent groups or other

subsets within a single settlement. Population counts for these *repartimientos* use the categories of boys (males under 18), tribute-paying men (males 18–50), and old men (males over 50). All females are lumped under a single category. When the data from *yanakuna* households are grouped into the same categories as contemporaneous *tasa* records from the Yucay region—an indigenous population of approximately 20,000—the percentages of boys, tribute payers, and old men in the Yucay household survey are comparable to those of the region as a whole, as is the sex ratio (table 2; data are from Cook 1982b).

The demographic data from the Yucay *yana* households do not represent a single native community, but the overall structure of the sample is compatible with tributary populations from the surrounding region (which are organized in administrative units that do not reflect indigenous community organization). While it is reasonable to consider the household surveys as representative of local demographic conditions, we do not attempt to extrapolate our results beyond the Cusco region—the evidence from ethnohistory and bioarchaeology indicates variable local outcomes in the aftermath of contact (cf. Crosby 1992; Larsen 1994; Newson 2003; Steckel and Rose 2002).

## Demographic Characteristics of the Yucay *Yanakuna*

As described above, the Yucay Valley survey provides a separate listing for every household. Each individual within the household is listed by name and age, with separate columns used to record parents and children. For some adult males, information on birthplace and ethnic affiliation was also recorded. A person’s sex can be easily determined on the basis of gender-specific first names (e.g., Francisco versus Francisca).

Although the household surveys record precise numbers for each individual’s age, the uncorrected population profile indicates inaccuracies in age data. When precise ages are not known in a population, there is a tendency to estimate individuals’ ages to the nearest figure ending in 0 or 5 (for other discussions of age heaping in early Colonial Andean populations, see Cook 1981; Ramírez-Horton 1978). Such a tendency is evident in the Yucay data (Covey and Elson 2007). Age heaping is especially noticeable among women, where

Table 2. Comparison of Yucay *Yanakuna* with tributaries in the province of Yucay in the 1570s

Sample	Tributaries (18–50; %)	Boys (<18; %)	Old men (>50; %)	Sex ratio (M/F)
Yucay Province	20.11	22.53	3.86	85.0
<i>Yanakuna</i>	20.31	20.83	4.49	83.9

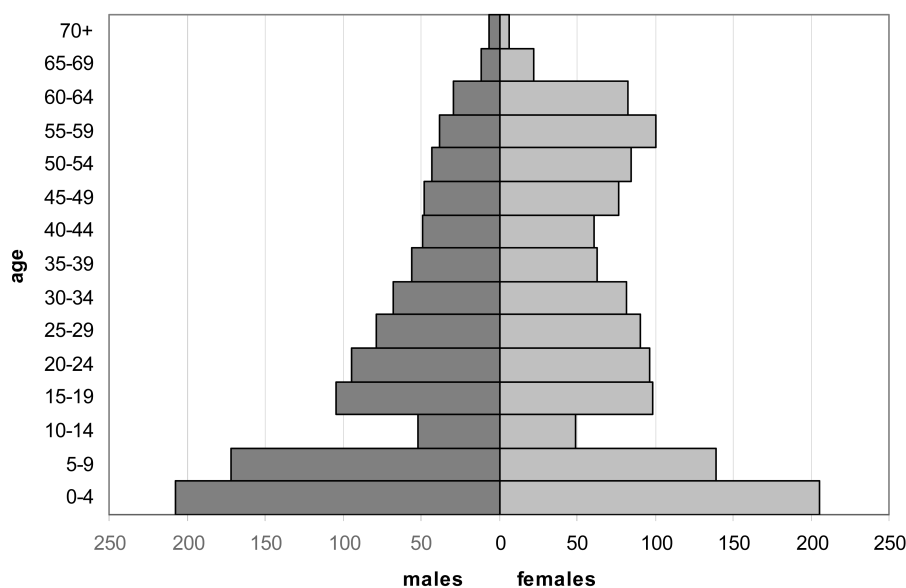


Figure 2. Adjusted population by age and sex, Yucay, 1569.

disproportionate numbers are listed as having ages ending in 0 (e.g., 20, 30, 40).<sup>2</sup>

#### *Age-Sex Composition and Mortality*

Figure 2 displays the age-sex composition of the population after adjusting the original data to attain a more smooth age distribution.<sup>3</sup> The numbers of people in each age group (unadjusted and adjusted) are presented in table 3.

The data presented in figure 2 and table 3 provide important clues about some demographic trends experienced by this population, including mortality. First, there are significantly more women than men aged 45 to 64, and in fact this cohort of women is relatively large compared to other age groups of women. At present, we are unsure why this anomaly in the population exists, but we speculate that it may be related to disruptions occurring in the decades before the household survey. Several studies have found that during famines, females experience a higher rate of survivorship than males (e.g., Boyle and O'Gráda 1986; de Waal 1989; Dyson 1991). Macintyre (2002) summarizes several potential reasons for excess male mortality. These include the fact that women have a higher proportion of body fat that increases their ability to survive periods of nutritional stress and that women, due to

their domestic roles, are more adept at locating wild "famine foods" during times of crop failure.

The marked surplus of older women may indicate stresses to the male population that were most intense from 1539 to 1549, or 20–30 years before the census was taken. This period corresponds to some of the most disruptive years of the Inka-Colonial transition, a period during which military conflict and radical economic reorganization were occurring in the Cusco region (table 4). Civil unrest disrupted food production and depleted local food stores, while indigenous men were pressed into conflicts as porters or soldiers. The surplus of

Table 3. Unadjusted and adjusted population by age and sex and sex ratios, Yucay, 1569

Age	Unadjusted			Adjusted		
	Males	Females	Sex ratio	Males	Females	Sex ratio
0–4	207	205	101.0	207	205	101.0
5–9	172	139	123.7	172	139	123.7
10–14	52	49	106.1	52	49	106.1
15–19	94	89	105.6	104	99	105.4
20–24	105	107	98.1	95	97	97.6
25–29	79	68	116.2	79	91	87.8
30–34	68	104	65.4	68	82	82.9
35–39	51	47	108.5	56	63	88.6
40–44	53	77	68.8	49	61	79.0
45–49	37	38	97.4	48	77	61.8
50–54	54	124	43.5	43	85	51.0
55–59	31	56	55.4	38	100	38.2
60–64	36	127	28.3	29	83	34.7
65–69	9	9	100.0	11	22	49.9
70+	8	19	42.1	6	6	101.1
All	1,056	1,258	83.9	1,056	1,258	83.9

2. Whipple's index is commonly used to determine the degree of age heaping in a population. A score of 100 indicates no preference for a specific age, whereas a score of 500 indicates a complete preference. In this population, for ages ending in 0, Whipple's index was 220 for men and 368 for women. In other words, the tendency for enumerators to record peoples' ages in years ending in 0 was much stronger for women than for men.

3. The age distribution was smoothed by applying Karup-King multipliers (see Bogue, Arriaga, and Anderton 1993:5–69).

Table 4. Military activity in early colonial Cusco

Year	Events in Cusco
1536–1537	Manco Inca raises an indigenous army to drive the Spaniards from Cusco. Military actions occur in the Yucay Valley, where the Inka army is headquartered.
1538	Battle of Las Salinas in the Cusco Valley. The Pizarro faction defeats Almagro's forces and executes Almagro.
1538–1539	A second campaign by Manco Inca is unsuccessful, and Gonzalo Pizarro invades the Inka strongholds in Vilcabamba in an attempt to capture Manco Inca.
1539	Francisco Pizarro executes Inka priests, military commanders, and Manco Inca's wife in Yucay and takes the Yucay Valley as his <i>encomienda</i> .
1541	Assassination of Francisco Pizarro in Lima. His brother Gonzalo assumes management of the Yucay Valley on behalf of his children.
1541–1542	Rebellion of the younger Diego de Almagro, who takes Cusco from Pizarro's supporters and prepares a military campaign that ends in his defeat at the Battle of Chupas. He is arrested and executed in Cusco.
1548	Gonzalo Pizarro's rebellion (1544–1548) is defeated nearby at Xaquixaguana; the Crown assumes administration of the Yucay Valley.

older women in this sample may not directly indicate an increased mortality among male *yanakuna*, but it could indicate that large numbers of widows in the indigenous population could not be maintained in a monogamous tributary population and entered into personal service to support themselves (cf. Cook 1981:253).

Second, sex ratios begin to favor females over males by a significant margin starting with the 25–29 age cohort. One presumed reason for the sex ratio imbalance is that men suffered higher rates of mortality due to labor migration to coca plantations in the lowlands—one of the principal tribute categories for the Yucay *yanakuna*. Pedro Gutiérrez Flores records the deaths of four male heads of household who were listed by Escudero, two of whom are said to have sickened and died while performing tributary service in lowland coca fields (Covey and Amado González 2008a [1571–1572: fol. 320v, 328v, 345v, 391v]). Several early Colonial writers state that highland populations experienced high mortality levels when sent to perform hard labor in the humid lowlands of the Amazonian slope, where the most productive coca lands were located (e.g., Acosta 1940 [1590], bk. 4, chap. 22; López de Velasco 1971 [1574]:480–481; Toledo 1867 [1572]).

A third feature is the conspicuously small cohort of males and females aged 10–14. Since tributary service and marriage would not have affected this group, underenumeration does not seem a likely explanation for this pattern. It is more probable that some sort of demographic stress occurring a decade or so before the collection of the data reduced the birthrate drastically, increased the infant and childhood mortality rates, or both. Epidemics typically have a disproportionate impact on infants and the elderly, the most vulnerable age groups in a society (Burnet and White 1972). Severe economic disruptions, such as famines that often accompany epidemics or social upheavals, can negatively affect the fecundability of women, which in turn would lead to fewer births. Here, we hypothesize that the small 10–14 age cohort reflects a combination of these two demographic forces. While we do not attempt to link the data to a particular event, it is worth noting that several epidemics are known to have

affected other parts of the Andean highlands from 1558 to 1561 (Cook 1981:60–61; Polo 1913). Similar fluctuations in cohort size are seen in age-sex profiles from other early Colonial populations (e.g., Hadden 1967; Ramírez-Horton 1978).

A fourth feature of figure 2 is the noticeably large and expanding cohorts aged 5–9 and 0–4, evidence that the population was experiencing a high fertility rate in the 10 years before the enumeration. We hypothesize that this condition reflects a rebound in fertility in the wake of a period of prolonged demographic stress. This observation is supported by the fertility analysis presented below.

#### Fertility

To estimate fertility, we used the own-children method (henceforth, OCM), a reverse-survival technique designed to calculate total fertility rates (TFRs) in the absence of detailed data on reproduction (see Cho, Retherford, and Choe 1986). Reverse survival, also called reverse projection, uses a population's current age structure and assumptions about mortality to reconstruct that population's age structure at a previous time.<sup>4</sup> For the most part, the OCM has been applied to large data sets such as national censuses from various countries (e.g., Haines 1989; Retherford, Cho, and Kim 1984; Retherford and Thapa 1998). The method has also been used to estimate fertility in small-scale populations studied by anthropologists (Childs 2003; Schroeder and Retherford 1979).

We chose to use the OCM here because it is one of the few methods available to estimate fertility from a limited data source such as the Yucay Valley household survey. Critically, one needs to be able to link children with their mothers, which is possible in this household survey. Data requirements for

4. The total fertility rate (TFR) is a standardized measure of the average number of children that would be born to each woman if age-specific fertility rates (births in a year to women aged  $x$  divided by the number of women aged  $x$  at midyear) remain constant. The TFR is an estimate of the number of children that would be born to a hypothetical cohort of women, not to an actual cohort of women.



Table 5. Total fertility rate by female life expectancy ( $e_0$ ) and time period, Yucay, 1561–1570

$e_0$	Time period			
	1561–1564	1565–1567	1568–1570	1561–1570
20	6.4	12.2	8.8	8.9
25	5.5	10.7	8.3	8.0
30	4.9	9.7	7.9	7.3

applying the OCM are the following: (1) all children (aged 0–14 whose mother is identified) classified by age and mother's age, (2) all children (aged 0–14 whose mother is not identified) classified by age, (3) all women (aged 15–64) classified by age, (4) an estimation of child survivorship, and (5) an estimation of female adult mortality. In the case of the Yucay household enumeration, the document provides data to meet requirements 1, 2, and 3. Because the age group 10–14 is so small, we restricted our analysis to the last 10 years and therefore included only children aged 0–9. For requirements 4 and 5, we relied on model life tables (Coale and Demeny 1983) and, in line with what is known about Andean populations at this time (e.g., Cook 1981), assumed that mortality was high. Therefore, we ran three different fertility estimates under the assumptions that life expectancy at birth ( $e_0$ ) was 20, 25, and 30 years.

The results of the fertility analysis are presented in table 5. Because of the relatively small size of the population, the TFR varies significantly from year to year. To compensate for some of this variation, we calculated TFRs for the entire 10-year time period (1561–1570), as well as for three intervals within that period (1561–1564, 1565–1567, and 1568–1570).

According to this analysis, the TFR was relatively low (4.5–6.4 births per woman) from 1561 to 1564 and rose sharply (9.7–12.2 births per woman) from 1565 to 1567 before de-

clining (7.9–8.8 births per woman) in the last time interval. For the entire decade, we estimate that the TFR was between 7.3 and 8.9 births per woman. Figure 3 presents data on age-specific fertility rates for the years just before the household enumeration.

Age-specific fertility rates peak in the 25–29 age group, which is often the highest-fertility cohort in populations that do not use contraception. Fertility then declines throughout women's reproductive years. The pattern resembles that of a population wherein fertility is moderated through birth spacing rather than parity-dependent stopping behavior.

The evidence we present here suggests that fertility recovered rapidly after the traumatic events of the late 1550s. Such a pattern, sometimes referred to as “recovery fertility,” is typical of a population that has recently experienced a demographic downturn (e.g., Livi-Bacci 2001). Clearly, people were reproducing at a rapid rate from the middle of the 1560s to the time when the household register was compiled.

Even under conditions of high mortality, as indexed by the low life expectancies, the TFR in this population was presumably sufficient to generate a population increase. Although there is no way directly to estimate the population's rate of growth during the 1560s, given the data on hand, we can at least demonstrate that the population had the potential to grow if conditions remained constant. The net reproductive rate (NRR) is “a measure of the number of daughters who will be born to a hypothetical cohort of women, taking into account the mortality of the women from the time of their birth” (Palmer and Gardner 1994:97). Providing that fertility and mortality remain constant and discounting migration, an NRR of 1.0 means that the population will numerically replace itself because each woman will have one daughter who survives to reproduce in the future. An NRR less than 1.0 means that the population will not replace itself and decline in num-

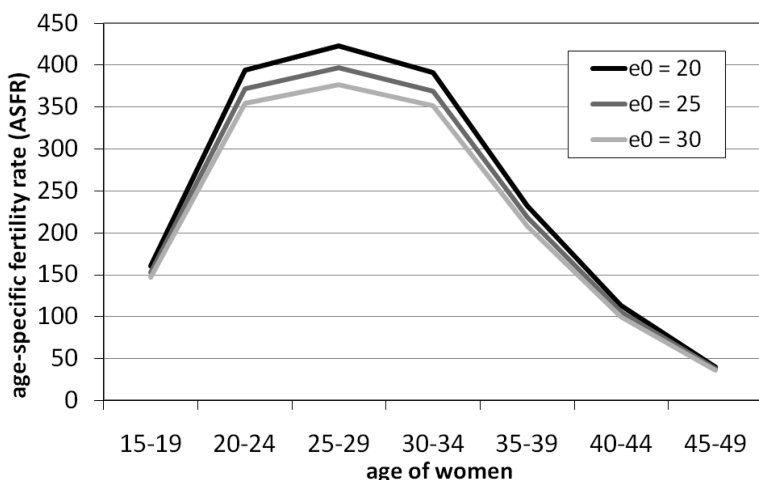


Figure 3. Age-specific fertility rate by female life expectancy ( $e_0$ ), Yucay, 1568–1570.

Table 6. Net reproductive rate (NRR) by female life expectancy ( $e_0$ ), Yucay, 1568–1570

Life table	$e_0$	NRR (daughters per woman)
South Level 1	20	1.29
South Level 3	25	1.52
South Level 5	30	1.72

bers because fewer daughters will replace the current cohort of mothers. An NRR above 1.0 means that the population will more than replace itself and grow because there will be a larger cohort of mothers in the future (Rowland 2003:246).

Table 6 presents NRRs calculated for the period 1568–1570 using the age-specific fertility rates presented above and model life table data corresponding to the life expectancies used in the OCM analysis (Coale and Demeny South Levels 1, 3, and 5). According to this analysis, during the time period 1568–1570, the women enumerated in the register were producing more than enough daughters to replace them. In other words, if mortality and fertility conditions remained constant over time, then this population would have grown—as we will discuss, this did not occur.

### Migration

The OCM analysis provides a means to assess fertility rates among the Yucay *yanakuna*, but the method has certain limitations that should be addressed. Specifically, fertility estimates can be biased if the population is not stable or if the rate of migration is high and involves a large number of couples in their prime childbearing ages. For example, because rural areas tend to have higher fertility than do urban areas, recent migrants to cities who had their children while living in the countryside would artificially boost an OCM-derived fertility estimate for the urban population (Cho, Retherford, and Choe 1986). To the extent possible, it is important to evaluate the effects of migration on the population registered in the Yucay household surveys.

Older cohorts of the Yucay *yana* population reflect Inka period migration practices, while families with young children appear to have transitioned to new tribute and service patterns under Spanish rule. In the household survey, 279 men identified their place of birth, of whom nearly half ( $n = 134$ ) were born outside the Yucay Valley. As table 7 shows, birthplace information is more readily available for younger men, and there are clear correlations between age and migrant status.

Approximately 60 of the migrants came from towns in the Cusco region, but most came from other parts of the Andes (see Covey and Elson 2007). The youngest migrants to the Yucay Valley were natives of other parts of the Cusco region, while the older men—those born before the European invasion—more often came from a greater distance, with high representation of the Cañari group of the highlands of what is today Ecuador. More than half of the men stating that they

were born in the Yucay Valley were descendants of migrants, representing more than 20 named groups—local Inka groups, as well as more than a dozen provincial populations. The household survey does not provide information on women’s birthplaces, but it is reasonable to assume that some women migrated to the Yucay Valley as well (Covey and Elson 2007).

As a nontributary population, the Yucay *yanakuna* served different Andean and European masters who placed them in the valley and typically provided them with agricultural lands for their sustenance. Migration into and out of the valley would most likely be linked to service requirements or to flight from such requirements. When Gutiérrez Flores ratified the household data from Escudero’s notebook in 1571, it appears that during the previous 2 years, two men had fled the valley, one of them because he was accused of murder (Covey and Amado González 2008a [1571–1572: fol. 357v, 396v]). The 1569 household survey suggests that large-scale flight was not occurring among the Yucay Valley *yanakuna*—instead, migration was reduced and localized from patterns seen in Inka times and the first years of the Colonial Period. Emigration from tributary communities became common in the Cusco region during the seventeenth century, an effect of Toledan resettlement policies of the 1570s, oppressive mining service requirements, and the increased role of indigenous wage labor in the colonial economy (cf. Cook 1990; Stavig 1999; Wightman 1990).

In recognition that an unstable population could affect OCM-derived fertility estimates, we focused the analysis exclusively on the 10-year period before the survey to minimize the impact of previous demographic fluctuations. Of the *yana* households with children in the OCM fertility sample, birthplace is identified for 157 male heads of house (representing 364 children). Roughly half of these men were born in the Yucay Valley ( $n = 79$ ; 181 children). Of the other half ( $n = 78$ ; 183 children), most of those for whom there was a record of service reported working for their current masters for at least a decade ( $n = 43$ ; 94 children). Twenty-five migrant males with children in the study started service with their current master less than a decade earlier (although this does not mean that they migrated at that time), of whom the majority were born in the Cusco region ( $n = 17$ ; 47 children). Only seven men (with 17 children) were long-distance migrants (from Soras, Huánuco, Huaylas, and Quito) who entered their current service within the previous decade. This

Table 7. Birthplace data for adult males in the Yucay Valley

Ages	Count	Birthplace stated (%)	Native (%)	Migrant (%)
14–20	86	56 (65)	41 (73)	15 (27)
21–30	170	90 (53)	60 (67)	30 (33)
31–40	116	64 (55)	29 (45)	35 (55)
41–50	82	34 (41)	7 (21)	27 (79)
51–60	83	29 (35)	8 (28)	21 (72)
61+	19	6 (33)	0 (0)	6 (100)

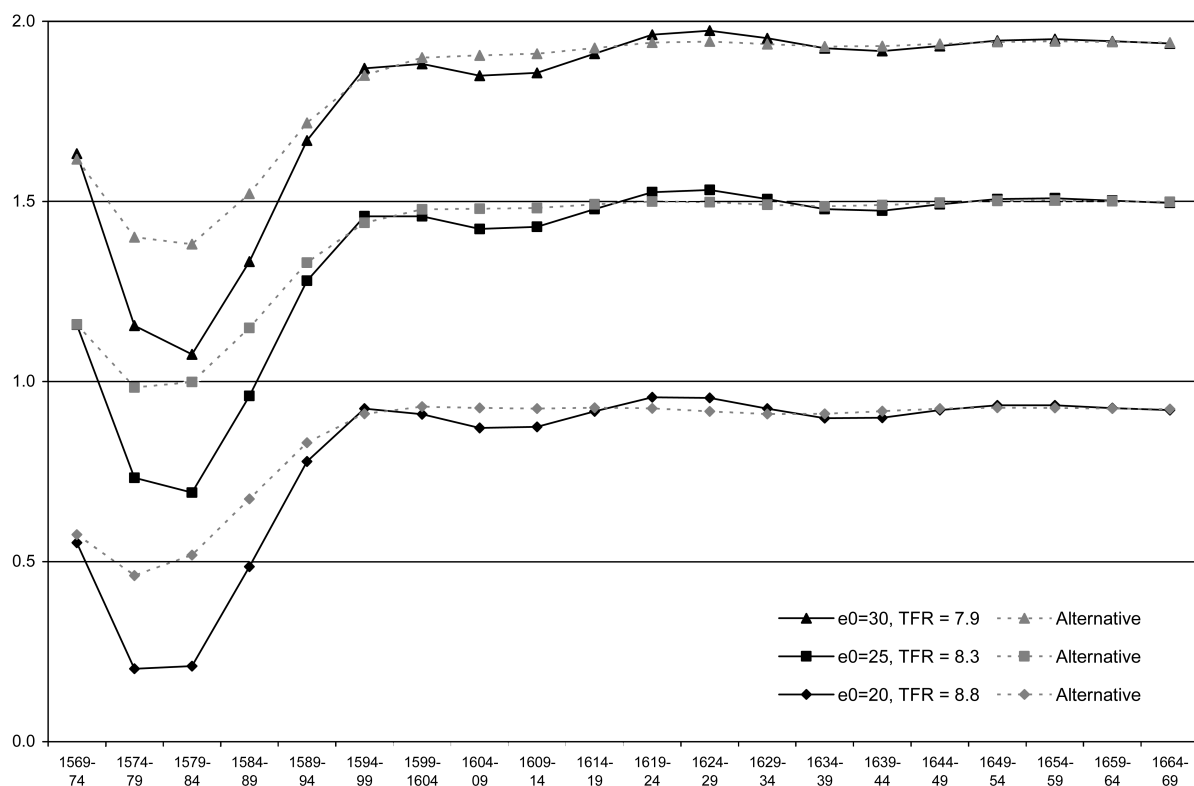


Figure 4. Projected annual growth rate (%), given selected levels of female life expectancy ( $e_0$ ) and total fertility rates (TFRs), Yucay, 1569–1669.

is admittedly a rough measure of immigration, but it suggests that the decade for which we consider fertility rates was one that was relatively stable, characterized by modest levels of local rural to rural migration that would not have forced in-migrants to alter their reproductive behavior to adjust to significantly different socioeconomic conditions.

## Discussion

The household survey of the Yucay Valley *yanakuna* provides crucial details for understanding the demographic effects of the Inka-Spanish imperial transition in the Cusco region, in particular, details that allow us to advance a more nuanced model of indigenous population decline during the establishment of Spanish colonial rule.

### *Evidence of Demographic Stress*

To recapitulate, the age-sex distribution for the Yucay Valley *yanakuna* reveals clear patterns that suggest demographic stresses over time in this particular subset of the indigenous population. The first is a high female/male sex ratio, with a disproportionately large cohort of older women. This may be linked to disruptions during the first decade or so following the European entry into the Cusco region (before 1550). The

second important pattern is the small cohort size of children aged 10–14, which probably reflects a period of elevated infant mortality, reduced fecundity, or a combination of the two during the late 1550s. We interpret these two features of the population pyramid as indicators of multiple periods of demographic stress on the Yucay population. The conclusion that warfare, food insecurity, and epidemic disease combined among rural indigenous populations is not itself surprising, but our data set also provides important perspectives on fertility rates during this period of upheaval.

### *Recovery Fertility*

Scholars have interpreted the postcontact effects of disease, famine, and other natural disasters primarily in terms of increased mortality, in part because of the difficulties in assessing fertility patterns over time (but see Livi-Bacci 2003; Whitmore 1992). Most early Colonial Period data sets provide insufficient information on mothers and children to reconstruct patterns of reproduction. Because the Yucay data are structured at the household level, it has been possible to use OCM analysis to reconstruct fertility for the period immediately preceding the registration of the *yana* households. The results indicate that while natural disasters, epidemics, and

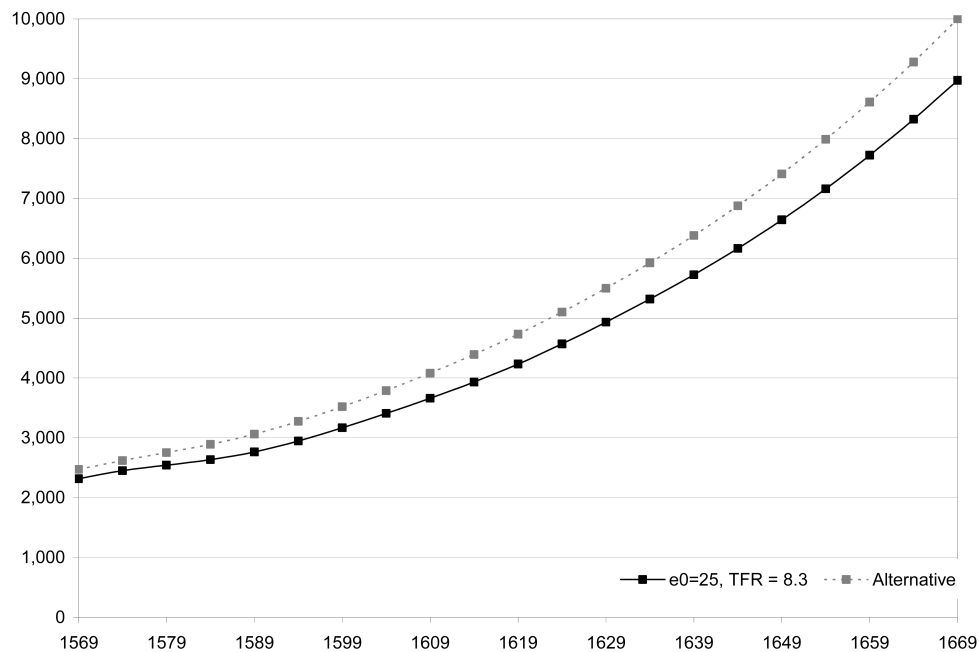


Figure 5. Projecting population size, Yucay, 1569–1669.

social disruption could periodically depress fertility and increase infant mortality, the passing of such conditions was followed quickly by a high recovery fertility that soon fell back to levels that, all other factors being held constant, easily should have been sufficient for replacement. This suggests that the Yucay *yanakuna* responded to imperial disruptions successfully enough, at least during some short-term periods, to form new family units and manage local subsistence needs and tribute requirements. It also provides sufficient detail to conclude that population declines were not constant over the course of the first century of Spanish colonial rule.

#### *Adapting to a New Empire*

The first decades of Spanish rule introduced significant changes among rural Andean societies (e.g., deFrance 1996, 2003; Jamieson 2000; Wernke and Whitmore 2009). The Yucay Valley data indicate reproductive rates above replacement levels, a testimony to the resilience of the *yana* population. In addition to the social, political, and economic transformations occurring in the former Inka heartland, the *yanakuna* of the Yucay Valley adapted to significant alterations to their subsistence economy.

The introduction of European plants changed the subsistence calculus for the Andean highlands (see Acosta 1940 [1590], bk. 4, chaps. 31, 32). Over time, new plants were adapted to the climate and seasons of the Cusco region, and accounts of the introduction of new cultigens (e.g., Garcilaso de la Vega 1965 [1609]) describe a two-phase process in which new plants were introduced and then brought into economic

use. Crops such as wheat and barley were well established by the 1540s, but the introduction of European vegetables, orchard trees, and other plants continued for decades. The increase in European cereal production led to the construction of mills throughout the region, which were often owned by wealthy Spaniards or religious orders. Spaniards eager for a taste of their natal land sought well-watered and temperate locations to place gardens and orchards, and the Yucay Valley was one place where available farmland was reallocated by municipal officials (Covey 2008; Cieza de León 1986 [1553], chap. 94). Changing food values would have had an impact on land availability, as well as market prices for food surpluses.

As with European plants, new domesticated animals were introduced over time. In the first years of the Colonial Period, most European animals were maintained solely as breeding stock and were sold only in small numbers as a personal favor (Acosta 1940 [1590], bk. 4, chap. 33; Garcilaso de la Vega 1965 [1609]). Prices of these animals were high through the 1550s and 1560s, but by the last decade of the sixteenth century, they had dropped to a fraction of early sale prices. European animals required different pasture than did Andean camelids, and these animals may have introduced new diseases to native animals—the spread of mange is said to have killed large numbers of camelids in the decades after the European invasion (e.g., Ondegardo 1917 [1571]; Flannery, Marcus, and Reynolds 1989; López de Gómara 1922 [1552], chap. 194). European animals changed the labor structure for the agricultural economy of Cusco. Garcilaso de la Vega (1965 [1609], bk. 9, chap. 17) recalls witnessing the first oxen-drawn plow

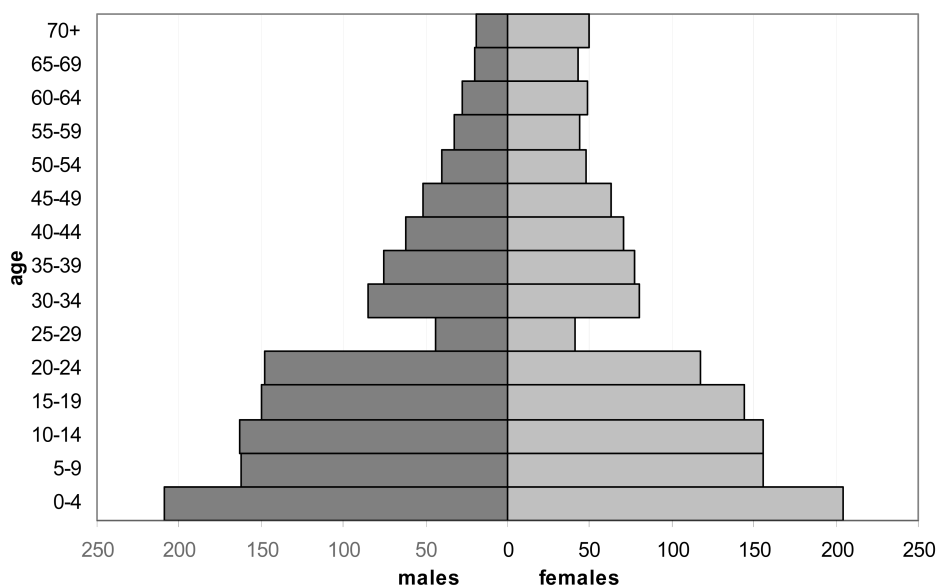


Figure 6. Projected population by age and sex, Yucay, 1584.

in the Cusco region in the 1550s, and by the 1570s, natives were encouraged to purchase cattle and plow farmland whenever possible (Toledo 1867 [1572]).

The high fertility rate among the Yucay *yanakuna* indicates that indigenous populations that had been radically restructured in the last decades of Inka imperialism were capable of negotiating a new imperial landscape successfully. Despite major social and economic disruptions occurring in the previous decades, the 1569 snapshot of the Yucay Valley suggests a population that could survive the typical demands of the Spanish colonial system.

#### *Long-Term Implications of Demographic Fluctuations*

The identification of recovery fertility has important implications for understanding long-term processes of indigenous population decline. Certainly, external factors, especially disease, had devastating consequences over the long run. However, in the face of periods of high mortality induced by epidemics and despite the imposition of massive administrative and economic changes, the data present compelling evidence that the indigenous population of the Yucay Valley was able to recover demographically, at least for short periods of time.

Unfortunately, the prospects of long-term recovery were compromised to some extent by the demographic legacy left by previous disasters. Consider, for example, the small cohort that was aged 10–14 in 1569. The women in that cohort would have been in their peak childbearing years during the 1580s. Even if their fertility rates remained high, by virtue of their small size this cohort would have produced a smaller number of children than their immediate predecessors. The result

would be the inverse of an “echo effect” observed when a large cohort, such as the United States’ baby boom generation, enters its reproductive years and produces a similarly large cohort.

To illustrate the demographic effect of the small 10–14 cohort, figure 4 shows six hypothetical projections of the population’s annual growth rate over 100 years from 1569. The solid lines project the growth rate of the age-sex structure in figure 2, assuming that life expectancy and fertility remain constant at the levels specified in table 5. The three dashed lines show “alternative” projected populations. These are based on the same life expectancy and fertility assumptions but with the small 10–14 cohort in 1569 adjusted to normal size by taking the average of the populations aged 5–9 and 15–19 in 1569.

The three projections based on the true population show a substantial reduction in the population growth rate in the period 1574–1589. The decline is particularly evident in 1579–1584, precisely at the time when women in the small cohort would be making their maximum contribution to overall fertility. The substantial reduction does not appear in the alternative projections with an adjusted 10–14 cohort. This difference demonstrates that the small 10–14 cohort in 1569 depressed population growth over the next 2 decades, due to its inability to produce the same number of offspring as a normal-sized cohort. However, figure 4 also illustrates that, under the mortality and fertility regime of the late 1560s, the population was capable of sustaining an annual growth rate of roughly 1%–2% in the long term. That is, the population had considerable growth potential if demographic conditions remained the same.

Table 8. Longitudinal changes in tributary populations in the province of Yucay

Repartimiento	Male 18–50	Male <18	Male >50	Female	Total
Yucay:					
1570	708	856	120	1,949	3,433
1602	500	368	141	973	1,982
Tambo:					
1575	209	169	40	501	919
1602	51	33	40	125	249
Laris:					
1575	242	228	53	719	1,242
1602	194	160	67	470	891
Matinga:					
1575	34	41	8	77	160
1602	22	22	13	43	100
Calca:					
1571	612	754	123	1,855	3,344
1602	378	340	189	1,056	1,963
Puquises:					
1575	209	293	28	617	1,147
1602	140	87	54	286	567
Lamay:					
1575	56	57	9	131	253
1602	37	41	11	78	167
Xaquixaguana de Coya:					
1575	366	445	109	1,124	2,044
1602	296	240	123	573	1,232
Amaybamba Maldonado:					
1575	61	62	17	114	254
1602	22	14	6	36	78

Source. Cook 1982*b*.

Note. Maras has a 1599 census for comparison, but it presents an unrealistic sex ratio, so the case study has been excluded.

Figure 5 projects the overall population size. To once again show the negative impact exerted by the small 10–14 cohort, the solid line is based on the real population, while the broken line, as above, assumes an adjusted 10–14 cohort. Both projections assume constant female life expectancy of 25 years and a TFR of 8.3 births per woman. Over 100 years, the cumulative effect of the small 10–14 cohort results in a loss of just over 1,000 people out of 10,000, or 10%.

However, it is important to note that the negative effect exerted by the small cohort on short- and long-term population growth trends would be magnified if the next demographic disruption occurred when that cohort was in its prime reproductive years. This is precisely what happened in the Cusco region when multiple waves of epidemics hit from 1585 to 1591 (Cook 1981:60–61). Note that the small cohort is aged 25–29 in our projected population for 1584 (fig. 6), which, according to figure 3, would be the time when fertility peaked for women in that age group. Disruptions to the food supply and family structure would presumably reduce fertility rates by reducing women's fecundity and would increase mortality among infants and children. Over the course of decades, the continuous impact of periodic epidemics would be compounded by the legacy of previous demographic disruptions, thereby counteracting the population's demonstrated ability to achieve short-term rebounds.

Fertility would be expected to recover after these stresses

passed, but the number of indigenous males available to enter tributary service in the first decade of the seventeenth century would be significantly reduced. This would be the first time that a problem would be obvious to Spanish administrators—declines in the number of tributaries would eventually attract administrative attention, but they were delayed epiphenomena of the actual dynamics of demographic collapse. The 1602 census data available for several *repartimientos* in the province of Yucay do show a different demographic makeup from what was seen in the region in the 1570s (table 8). For the communities where longitudinal data are available, overall population declined by 44%, and there were several significant shifts in age-sex characteristics, including (1) a 27% increase in the number of older men (representing the exit of a “healthy” cohort from tributary service), (2) a 55% decrease in the number of under-18 males (the pool for future tributary service), and (3) a significant decline in the sex ratio as female population dropped by 49%. Over time, demographic downturns would have become more prolonged or intense, as the next major epidemic in Cusco (1614) coincided with the period when individuals born during the 1580s epidemics would be in their prime reproducing years. The demographic fluctuations created by these “bust/boom” oscillations in fertility and survivorship were beyond the comprehension of Spanish colonial administrators—their data were simply too coarse-grained. The lack of demographic understanding no doubt

contributed to the hardships inflicted on local populations when administrative policies, such as levels of tributary obligations, were not adjusted in response to rapidly changing demographic realities.

Furthermore, such patterns may provide important clues for understanding the dynamics of local demographic trends in the Andean region during the first century or so of Spanish rule. Specific trajectories would depend on the environment, fertility rates, migration patterns, and phasing of localized demographic stresses that included famine, disease, and other factors. For example, coastal populations would be subject to the long-term fluctuations of disease, as well as the periodic effects of El Niño–Southern Oscillation. Earthquakes and volcanic eruptions would also reverberate over time in local demographic profiles in other regions. Disasters (including disease) would be felt at the time that they occurred, but they would also be experienced years later, as new tributaries failed to enter into service to satisfy tribute levies that were only periodically reassessed. The stochastic effects of demographic oscillation raise the question of whether smaller indigenous tributary units were at greater risk of experiencing population crises that would abruptly raise per capita tribute requirements and encourage flight from the community.

## Conclusions

The letters and ordinances of Peru's early viceroys frequently express concern for the well-being of the indigenous population, statements that were intended to justify maintaining or altering imperial policies. The onerous demands placed on native Andeans by the Spanish Crown leads one to question the sincerity of such statements, as does the reluctance of colonial administrators to conduct new census counts and tributary adjustments. Royal officials were concerned with the bottom line rather than fluctuations in per capita liabilities at the village level, and it is clear that service in mines and coca fields took many lives and encouraged flight from tributary communities. Even though Spanish administrators lacked the tools to measure and mitigate the demographic processes that led to long-term population decline throughout Peru, a more humane policy would have involved frequent reassessments of local populations and tribute levies. Tributary populations fluctuated significantly over time, while tribute demands were reassessed only periodically—at times, macrodemographic cycles would have placed significant burdens on indigenous communities, which in turn probably contributed to conditions (poverty, malnutrition) favoring the spread of epidemic disease and enhancing its morbidity (Bonds et al. 2010; Young and Jaspars 1995). While indigenous populations showed considerable resilience in the face of imperial transformation, we hypothesize that the boom-and-bust cycles created by pandemics and exacerbated by insensitive administration drove the long-term trend of population decline observed in the Yucay Valley and probably in other parts of the Cusco region. Hopefully, the discovery and anal-

ysis of similarly robust data sets will provide comparative data to demonstrate the extent to which such cycles may be identified in the process of colonial expansion in other parts of the globe.

## Acknowledgments

Sabine MacCormack initiated and generously supported the transcription of the Yucay Valley documents, which was completed in collaboration with Donato Amado. The National Science Foundation (BCS-0342381) and the National Endowment for the Humanities supported R. A. Covey during the final phases of archival work, which would not have been published without support from Joyce Marcus, who also read early drafts of this paper. Lauren Gulbas also gave feedback on several versions of the manuscript, and her comments and those of five anonymous reviewers helped us to identify ways to strengthen the final paper.

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## Comments

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17 II 11

Attempts by anthropologists and historians to reconstruct Andean demography during the transition from Incario to colonial state often founder on woefully inadequate historical sources. The generic obstacles to this exercise are well known. The sheer scarcity of sources and, where available, their unreliability, inaccuracies, and lack of qualitative context, render the task intractable. This is above all true for the sixteenth century, for which parish records, so plentiful for later centuries, are almost entirely nonexistent. The present collaboration by Covey, Childs, and Kippen is a fresh approach using data that is as good as it gets for the early Colonial era. Problems of data reliability and method aside, this study is a major step forward in understanding the response of two indigenous groups of the inner Inca heartland to the onset and the vicissitudes of early Spanish colonialism; it is particularly welcome because the 1569 data were registered during the first generation after the full onset of “virgin soil” diseases.

Alan Covey is one of the very few archaeologists to have undertaken detailed historical research in colonial documentation. Combining archaeology and ethnohistory holds great potential, though it is crucial to get the archaeology right and the history right and then see how the two can be usefully combined and not least to identify contradictions. This article is highly interdisciplinary, with scrupulous attention to method; a related article by Covey is instructive (Covey and Elson 2007). Its laboratory is the Vilcanota Valley of the Cusco

region, an agriculturally rich microregion capable of sustaining a large population and a complex society. The very richness of its estates—the royal estate of the Emperor Huayna Capac was located there—and its proximity to the city of Cusco account for the wealth of detailed information on the valley for late Incan and colonial periods. Much of this qualitative and quantitative data were, in late colonial times, collected (to support litigation) into a multivolume repository known as the Betancur collection; Covey and *cusqueño* historian Donato Amado Gonzáles have transcribed and translated the first and perhaps most valuable volume of the collection (Covey and Amado González 2008a). The authors have access, therefore, to a particularly “robust” data set for the era, which they analyze deftly and generally convincingly.

The data set pertains primarily to *yanakuna* groups, as well as other nonspecific indigenes categorized as “tributary.” The former embraced an internally stratified Incan servitor group plus others reduced to this nonethnic category by the early Colonial state. As the authors note, the *yanakuna* were non-tributaries, and census data were less likely to have been skewed by the fraudulent counting common to colonial censuses; some other indigenous groups were also tribute exempt, such that some tribute lists undercount the total population. This relative reliability is also useful in evaluating the “stochastic effects of demographic oscillation.” The comparative data on total population and number of (always male) tributaries are much less solid; these are organized by town but omit details of pre- and postconquest lineages (*etnias*). Nonetheless, it is the rich *yanakuna* data that provide the focus, and the analysis of demographic composition is convincing.

One aspect overlooked in this study is the clergy’s role in keeping parish rolls, as well as parish registers. While these are rarely extant for the early Colonial era, the state relied on the rural parish clergy to superintend the welfare of their indigenous flocks; this rather qualifies the authors’ strictures on the state’s alleged neglect. Some qualitative late colonial research indicates that Church imposts were a greater burden than state taxes on indigenous communities. One impost pertained to baptisms, mandatory in Catholic praxis, and colonial testimony alleges that many indigenous families kept news of births from priests in order to avoid this charge. Moreover, because of high infant mortality, this resulted in clandestine child burials so as to avoid, in turn, funeral fees. The fact that so many infant births were hidden would affect fertility calculations, though in which way cannot be known, given the absence of pertinent data. However, the authors are well aware of the wide range of variables that surrounded any attempt at census, and their qualitative judgments nicely balance their numerical analysis.

The principal caveat concerns the use of “the own-children method (henceforth, OCM), a reverse-survival technique designed to calculate total fertility rates (TFRs) in the absence of detailed data on reproduction.” This is the first time that this technique has been employed in Andean historical demography (and perhaps elsewhere in the Americas). Like all

models, it is based on multiple assumptions; given the fragility of the authors’ data set, its application can produce only results that are highly tentative, as the authors acknowledge. Even so, this approach, if perhaps controversial, also advances the research agenda for colonial demography. It clearly poses an intriguing hypothesis capable of being tested when other solid data sets are available (as they are for the eighteenth century). Finally, the qualitative context and analysis in this study are reliable and draw on several sets of scholarly literature.

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A common challenge facing researchers who work with rich and largely unknown data is to avoid the pitfalls of assumed uniqueness of their documentation and its broader significance. Covey, Childs, and Kippen’s arguments are based on a detailed 1569 household count of about 800 living in Peru’s Yucay Valley. They argue that their sample from the Inca heartland is representative, critical for Andean wide generalizations. On the one hand, they say “we do not attempt to extrapolate our results beyond the Cusco region,” yet on the other hand, they claim elsewhere broader relevance.

I would caution against Covey and colleagues’ choice of the *yanaconas* (servants or retainers) of Yucay for stable population analysis. Such analysis requires little significant migration, yet the valley’s population was heavily migrant. Since the “Sacred Valley” was part of the Inca Huayna Capac’s personal estate outside Cuzco and for his panaca destined to service his ancestor cult, most *yanaconas* came from outside. Under Spanish domination, the valley was close to colonial Cuzco, focus of administration of a large section of the southern highlands. Given its ideal climate, fertile, level soil for agriculture, and proximity to the city and the fact that it belonged to the Inca, Yucay was taken in *encomienda* by Francisco Pizarro. The chaos of the native uprising of 1535–1537, subsequent war between the Pizarrists and the Almagrists, and then the revolt of the *encomenderos* negatively impacted the valley’s population. Some migrants may have returned to their native communities during the first decades. Simultaneously, the Spanish settled some Cañaris (roughly between modern Peru and Ecuador) in the valley in return for services in the conquest. Further, since the valley’s soil proved flat and fertile, it became one of the earliest centers for introduction of European oxen plow agriculture. The impact of Old World agriculture came quickly, and the shift from traditional Andean agriculture was more complete than in many other areas. Proximity to Cuzco brought things and then plants, animals, and a mixed and migratory population: epidemic disease. It



is a stretch to use the Yucay sample as a yardstick for the rural Andean population masses elsewhere.

Covey and colleagues estimate fertility rates by using stable population analysis and the own-children method, a reverse-survival technique designed to calculate total fertility rates in the absence of detailed data on reproduction. They recognize that migration can bias fertility estimates and note that half of 271 men who indicated birthplace in the Yucay count were migrants. Yet, taking a subset of the men, they conclude that “it suggests that the decade for which we consider fertility rates was one that was relatively stable.” Their result is debatable, given significant migration. Nevertheless, they present a promising application of the model that could be tested elsewhere where data are better. Their conclusions about rapid recuperation following epidemics are similar to what happened in the Colca Valley. There, too, the number of births in the first 2 years after major epidemic crises rose sharply, as did the number of marriages. Further study of the Colca’s population is consistent with the view of resistance to shocks of the Columbian exchange and colonialism, at least in a core area of the rural highlands (Cook 1982a; Cook with Cook 2007).

Covey and colleagues assert that the Yucay 1569 household count allows them to “explore critical demographic processes that are difficult to document in the more coarse-grained data available for other parts of the early Colonial Americas.” Yet other data, including and following Viceroy Francisco de Toledo’s counts, are just as detailed as Yucay’s. Covey and colleagues’ observation that “Toledan counts were limited to a few basic gender and age distinctions at the level of the tributary grant” is wrong. They likely refer to the summaries of counts (Cook 1975). Original counts include names, age, sex, and marital status. They are arranged by household and often include other information on *ayllu* and *saya* (roughly moiety) affiliation, agricultural holdings, and production. The 1562 count of Los Chupachos in the Huánuco district (Ortiz de Zúñiga 1967–1972) may have served as a prototype for later counts. Toledo’s early 1570s visita of north highland Cajamarca (Rostworowski and Remy 1992) is one example of a handful of general inspection and tribute assessments under his administration. We have several later sixteenth- and seventeenth-century counts (Pease 1977; Robinson 2002, 2006) of *repartimientos* in the province of Los Collaguas in the Colca Valley, taken in many districts following devastating epidemics of 1589–1591 (Cook 1982a, 2002a; Cook with Cook 2007). Based on Inca population-counting tradition and recording, Andean counts may be the most complete in early Colonial Spanish America (Cook 2010).

There are many avenues to the study of population dynamics in the Americas in the decades following the encounter between the Old and New Worlds, and there are many theories as to the nature and relative impact of the forces unleashed (Austin Alchon 1991, 2003; Cook 2005, 2010; Crosby 1976; Denevan 1992; Newson 1986, 1987, 1995; Livi-Bacci 2006; Lovell 1992; Whitmore 1992). Covey, Childs, and Kippen take

here another important step in the road toward a better understanding of that complex process.

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The Yucay Valley demographic data from the sixteenth century offer an exceptional opportunity for a detailed analysis of population trends following the disruptions of Spanish conquest and early colonial rule. Covey, Childs, and Kippen exercise an appropriate level of caution when it comes to how widely their findings may be applied to other Andean regions, as well as for the difference between short-term recovery of fertility and long-term demographic fluctuations related to exposure to disease and abusive labor practices.

I have two questions. First, the authors partially explain a dramatically small cohort of males and females aged 10–14 by invoking the disproportionate impact of earlier epidemics on infants and the elderly. While this is a feature of many disease outbreaks (e.g., cholera), some of the most serious epidemics in the aftermath of conquest probably had exceptionally high mortality rates across the population. Many strains of smallpox, for example, have case fatality ratios that do not respect age. Is it not more likely that the loss of male partners due to conscription for the military and distant labor service during the first years after conquest reduced the number of pregnancies experienced by women left at home?

Second, the authors estimate a total fertility rate (TFR) for the decade 1561–1570 of between 7.3 and 8.9 births per woman. This strains credibility. In 2008, only Afghanistan and Niger had a TFR of 7, and no country had a figure over 8 (see UN Population Division 2009). Even the parents of the famous baby boom generation never reached a TFR over 4 births per woman. How could an indigenous population still experiencing the worst sort of societal collapse due to conquest, with adult men being taken away for long periods of time to fulfill tribute obligations, manage more births than in any contemporary country? I would like to see the authors provide some comparative context for their estimate and acknowledge that they are suggesting an exceptionally high level of fertility for a population that was still under extreme stress.

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To untangle the complex factors that have determined the decline of the Indian populations after the contact with Europe and Iberia is a fascinating task for the historian. But

data are scarce, generally collected for taxation purposes, often inadequate even for a superficial appraisal of the elementary demographic dynamics. Hence, scholars must be patient and wait for the accumulation of evidence that often arises from the fortunate encounter with documents that permit a deeper analysis of a village, a parish, a set of households. This is the case of Covey, Childs, and Kippen, who have located the inventory of *yana* households that were “reduced” in four villages of the Yuca Valley in 1571. This has emerged from the documentation of a long legal controversy concerning the inheritance of the grant of the tributary population of the valley.

This document details the names and ages of the components of each one of about 800 households. A preliminary question is addressed: were the *yanakuna*, given their particular status, representative of the population of the valley? The similarity of their basic demographic structure with that of the total population of the valley, as it emerges from Toledo’s *tasa*, convinces the authors that the *yana* were, in all probability, representative of the larger valley’s community. However, they should clarify a doubt arising from the data they present: the *yana* households are 800, for a total number of components of 2,304 (see table 3), or less than three persons for household, abnormally lower than the four to five normally found in other contexts. Is this consistent with the representativeness hypothesis?

Does the age and sex composition of the *yana* population reveal past mortality and fertility patterns? This is a risky business: the shape of the age distribution of a small population may reflect the influence of random factors; of systematic distortions in the survey’s age determination; of any combination of the past (unknown) patterns of fertility, mortality, and migration. Smoothing is of little use and may actually conceal interesting real peculiarities. The fact that above age 50 women are three times more numerous than men is attributed by the authors either to “disruptions occurring in the decades before the household survey”—famine and wars—or to the fact “that large numbers of widows in the indigenous population could not be maintained in a monogamous tributary population and entered into personal service to support themselves.” If this is so, the “representativeness” of the *yana* households is called into question.

The authors also note the peculiarity of age distribution under age 15 and in particular the very small size of the 10–14 cohort; in this case, if we exclude underenumeration (but can we?), this is probably more the consequence of the fall of fertility, due to some disaster occurring 10–14 years before the survey, than that of an increase of mortality that would have had a negative effect across ages and not only in a particular age group. Is there any evidence of serious disruptions for that period in the Yuca Valley?

More sound and revealing is the application of the own-children method (OCM) in order to estimate fertility in the decade before the survey (1561–1570): for the entire period, a total fertility rate of 8 (intermediate mortality level) is plau-

sible, consistent with other findings for comparable populations and typical of societies with a relatively low age at marriage and with a high proportion of women getting married. Splitting the decade into three subperiods reveals fluctuations that, again, are difficult to interpret. But the high fertility was the engine that, throughout the continent, allowed the Indian communities to survive the after-Conquest stresses and eventually rebound. When circumstances—dislocation, selective migration, or other stresses—crippled fertility, population collapsed. But this was not the sad sort of the Yuca Valley population.

Applying the model mortality patterns assumed for estimating fertility and the fertility schedule estimated by the OCM to the 1571 population allows the authors to calculate the hypothetical population size and structure in the following decades and the impact of the depleted 10–14 age group on the rate of growth. This is illustrative of the potential impact of past disturbances on population growth in the presence of stable mortality and fertility schedule, but the findings should not obscure the fact that demographic systems were highly reactive to circumstances and were seldom stable. As the authors say: “Specific trajectories would depend on the environment, fertility rates, migration patterns, and phasing of localized demographic stresses that included famine, disease, and other factors.” And only the multiplication of analysis such as the one carried out for the Yucay’s *yana* will make possible the reconstruction of the functioning of the post-Conquest demographic system.

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The paper by Covey, Childs, and Kippen is one of the best of a small number of truly demographic analyses of the destruction of the indigenous peoples of the Americas. Their analysis is sophisticated, informed, meticulous, and supple. Their conclusions are entirely persuasive, although overly cautious and sanitized.

It is surprising that the paper does not report a simple average family size or even the exact number of units—stated twice as “more than 800” households. An average family size of less than three ( $2,314/800 = 2.9$ ) would seemingly contradict their argument that fertility was sufficiently high for population growth, despite exceedingly high mortality.

The conundrum of how to square a total fertility rate (TFR) of 8 and a net reproduction ratio (NRR) of 1.5 with a mean family size of three is readily solved by a table of age by sex and marital status. I suspect that the table will show that in the Yuca Valley indigenous customs of child marriage were

still the norm a generation after conquest. Early universal marriage inflates the number of families as seen through Christian eyes, without increasing the number of children in the population because prepubescent child-wives are obviously childless.

Throughout the Americas, researchers interpret vanishingly small family sizes computed from taxation lists as indicators of “demographic decadence” (e.g., Carrasco 1964:76). Nonetheless, this obvious inference from a simple average is wrong, and Covey, Childs, and Kippen successfully evade this trap by their brilliant analysis. The small average family size is due to unimaginably early universal marriage (not to mention polygamy, which was apparently scrubbed from the Yucay lists). Countless colonial historians conclude that the small average can only mean that families were not successfully reproducing themselves. The lesson to be learned is that the average is small because the number of “families” is inflated by child marriages (McCaa 1996:23).

The marital status table offers another lesson. From the proportions single at each age, Hajnal’s (1953) singulate mean age at marriage (SMAM) may be computed. For Amerindian populations, care must be taken to include the proportions of single ages 10–14. SMAM is robust even where ages are heavily heaped because the computation involves cumulative sums of grouped data and yet yields amazingly precise single-year figures, even for innumerate populations. Kunesof (1998: 169) reports a shockingly low SMAM of 12.9 years for indigenous females in the northern Peru town of Cherrepe in 1572. A continent away (Morelos, Mexico) and a generation earlier (1530s), among the rural Nahua (“Aztecs”) the average was also a no less shocking 12.7 years for females (19 for males). Child marriage consummated by cohabitation was the norm in the Morelos listings written in Nahuatl, following indigenous, non-Christian conventions (McCaa 1996:26–29). Where 50% or more of females are married by age 15, SMAM will fall below 15 years.

There are two additional points I wish to make. First, 15 years ago I stated that heavily heaped ages make it impossible to detect epidemics in early contact village listings (McCaa 1996:33). Table 3 and figure 2 prove me wrong by revealing the devastating impact of the smallpox epidemic of 1558–1560 on the birth cohort 1555–1559 (age group 10–14). Excess mortality of infants and young children and a sharp contraction in births (in part due to near 100% mortality for those pregnant at any point while the epidemic raged) squeezed the birth cohort to one-half its normal size. A baby boomlet for postepidemic birth cohorts—noticeable in the pyramid—was too small to replace the loss.

What is not in the pyramid is a similarly squeezed older “x0–x4” cohort. If the Inca Huayna Capac was felled by a smallpox pandemic in the years 1525–1529, table 3 should be etched by a squeeze for that birth cohort (aged 40–44 in 1569). Although the authors do not speculate on the role of any particular disease, their data strengthen my conviction that smallpox erupted as a “virgin soil” epidemic among the

Andean peoples a quarter-century after Pizarro’s band first looted Tawantinsuyu. To prove me wrong, all that is required is a contemporaneous document showing a squeezed cohort born before 1555 or a single reference to a pockmarked native or bioarchaeological confirmation by means of a mummy before 1558. Meanwhile, as the years pass and the challenge goes unanswered, my conviction is strengthened that a smallpox pandemic before the Christian invasion of the Andes is an invention (McCaa, Nimlos, and Hampe-Martínez 2004).

Second, regarding the causes of the destruction of the native peoples, the authors rightly emphasize complexity. Nonetheless, I prefer Montesinos’s denunciation, echoed by Poma de Ayala for Peru, of oppressions and excessive labors and detestable wars to sterile academese blaming “insensitive administration,” implausible pandemics, or imagined famines. Diseaseologists have pushed the pendulum too far in blaming disease for the greater part of the destruction everywhere. The black history of Christian conquest in the Americas is no legend, certainly not in Tawantinsuyu (Assadourian 1994; Livi-Bacci 2008; Poma de Ayala 2004 [1615]:370–716). I look forward to following the authors’ research and studying their publications.

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Covey, Childs, and Kippen deftly engage qualitative and quantitative data sets in their exploration of sixteenth-century demographic fluctuations of a nontributary indigenous population in the Yucay Valley, Peru. In their analysis of household-level survey data, they find that women outnumbered men in the 45–64 age category, that sex ratios consistently favored women, that the 10–14 age cohort was notably smaller than the other age categories, and that two subadult cohorts (0–4 and 5–9 years) were larger than other subadult cohorts, which likely reflect an increase in fertility in this community, a result that is supported by their fertility analysis. Covey and colleagues then draw from historical and ethnohistorical records to contextualize their data and explain why this community may have experienced these particular demographic fluctuations. For example, they attribute the small size of the 10–14 age cohort to a reduction in birth rate and high childhood mortality caused by epidemics and accompanying economic disruption some 10 years prior, in the late 1550s. They conclude with predictions about how this population will fare, given shifting fertility rates, small age cohorts, and biased sex ratios. Importantly, their study represents one of the few fine-grained studies of the demographic effects of Spanish colonization in the Cusco region that uses household survey data.

The authors acknowledge that the *yanakuna* might not be

an appropriate demographic unit, and to test this, they compare it to Cook's (1981) data set from tributary populations in the Yucaj. It is difficult to evaluate whether the two are indeed comparable, given that no statistical analysis was performed and not all raw numbers were provided. Migration proves somewhat elusive to establish for this sample, and they grant that theirs is a rough measure, but it is important to acknowledge that reproductive behavior likely would have been affected by migration rates of women. As is the case with many studies in historical demography, the authors can only speculate about the exact causes for a reduction in fertility or an increase in mortality for certain age cohorts (e.g., which epidemic disease, when, etc.), but this does not detract from their study and its conclusions.

Recent bioarchaeological research has attempted to address some of the methodological and analytical challenges inherent to paleodemographic research, with important implications for studies of population composition, life expectancy, fertility, and mortality (Bocquet-Appel 2008; Boldsen et al. 2002; Buikstra, Milner, and Boldsen 2006; Hoppa and Vaupel 2002; Konigsberg and Frankenberg 2002; McCaa 2002; Milner, Wood, and Boldsen 2008), so it is unfortunate that there is no complementary bioarchaeological data for the region to compare with prehispanic bioarchaeological data (Andrushko 2007; Verano 2003) and this study. The expectation is that most indigenous populations declined after Spanish contact and invasion, but results evince tremendous variability in how conquest and invasion impacted indigenous communities (Baker and Kealhofer 1996; Larsen and Milner 1994; Larsen et al. 2001, 2002; Milner 1996; Steckel and Rose 2002). Covey and colleagues report an average total fertility rate of 7.3–8.9 births per woman for the decade (1561–1571), which I found an unexpected and interesting result, given the tumult in the Yucaj region in the decades following Spanish invasion and the collapse of the Inka Empire. McCaa (2002) also details fairly high rates of fertility among the historical Native American samples in his analysis, but few of those are from the Central Andes, and contact-era samples are not specified. In contrast, Klaus and Tam (2009) describe a postcontact decline in birthrate in the early Colonial and late Colonial samples from Lambayeque Valley on the north coast of Peru. Much remains to be understood about local demographic fluctuations in different communities in the Central Andes after Spanish conquest and invasion, and the study by Covey and colleagues is an important contribution.

While all researchers are in consensus that the indigenous population decline in the Central Andes was precipitous after Spanish colonization and that epidemic disease, warfare, famine, and economic upheaval were among the contributing factors, few opportunities exist for scholars to investigate demographic fluctuations on a small regional scale and to model the subtleties of indigenous population decline. From the Yucaj Valley, Covey and colleagues provide convincing evidence of population decline, followed by recovery fertility over the short term, and they demonstrate the long-term cumulative

effects of the demographic profiles they describe. The authors should be commended for their thorough and compelling investigation.

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Covey, Childs, and Kippen's study of population dynamics of the Cusco region in the sixteenth century asserts correctly that research on demographic change in the early Spanish Colonial Period has tended to emphasize the role of mortality and particularly the impact of Old World diseases and the Black Legend. This emphasis may be explained in part by the greater availability of numerical evidence for mortality; sources that allow some estimation of fertility rates, such as the household survey of the *yanakuna* in the Yucaj Valley in 1569 discussed here, are relatively few. As such, this paper contributes to redressing the balance.

The paper suggests that the Inka had high fertility, with the number of births per woman in the 1560s being between seven and nine. These figures suggest continuity from pre-colonial times when population growth was encouraged, among other things, by the distribution of land according to family size and the active promotion of marriage (Rabell and Assadourian 1977). Pre-Inka society can be described as having a high-pressure demographic regime that was characterized by high fertility but also high mortality and low life expectancy. While this meant that population growth was generally slow, as this study shows, societies characterized by high fertility did have the potential to achieve fairly rapid demographic recovery.

This study is important in drawing attention to the significance of the particular characteristics of a pre-Spanish demographic regime to an understanding of its colonial trajectory. Demographic recovery in general was highly influenced by the size of marriage pools, by cultural restrictions on marriage and remarriage, and by policies that promoted or restricted population growth. For example, among the Tupinambá, a man was required to kill a captive before marriage, a custom that, in theory, meant that each generation had to lose a quarter of its population in order to reproduce. This practice maintained high mortality levels and also delayed marriage, created imbalances sex ratios, and reduced fertility. Such practices were clearly inappropriate for survival in the Colonial Period, when a group's reproductive capacity needed to be maximized in the face of even higher levels of mortality.

With the previous observation in mind, we need to recognize the specificity of this analysis within the Inka context. The study examines a *yanakuna* population, which may or may not have been better placed to achieve recovery than other Andean communities. The authors suggest that pre-

Spanish populations in the Cusco region were relatively stable and had access to agricultural surpluses. However, they also note that the transition to Spanish rule was marked by military conflict and radical economic reorganization. These processes would have created a state of demographic flux. Frank Salomon (1986) and Karen Powers (1995) have shown for Ecuador that colonial *yanakuna* communities were often composed of persons displaced by political upheavals who were settled there by ethnic lords seeking to enhance their status. As such, they were agglomerations of individuals from diverse origins who were generally not related by kinship. This also seems to have been the case in the Yucaj Valley, where in 1569 nearly half of the men came from outside the region. How did this affect marriage patterns, and how typical were the population dynamics of these communities compared to those in the Andean as a whole? The authors recognize the importance of the issue of comparability and attempt to address it by breaking down the *yanakuna* population into categories found in other sources available for other communities in the Yucaj Valley. However, the limitations of the data mean that the numerical comparison is necessarily crude, and perhaps a more fruitful line of analysis would be to explore qualitative differences that may have existed between the two groups of communities, for example, in terms of access to land, marriage patterns, and tribute liability. The authors wisely accept that their results cannot be extrapolated beyond the Cusco region.

This study makes a useful contribution to our knowledge of fertility in the early Colonial Period. It demonstrates the role fertility can play in demographic recovery, but caution needs to be exercised in extrapolating the findings here to other societies, given the enormous variations in precolonial population practices and policies and the extent to which societies suffered disruption and restructuring in early colonial times. Even if this study's main contribution is understanding fertility, it also underlines the importance of the interrelationship between mortality and fertility in understanding demographic trends. For example, it shows that an excessive loss of population in a crisis may have a lingering effect on fertility as a depleted population cohort enters reproductive age. Modeled over a 100-year period, it suggests that a crisis might result in a population loss of 10%. The "boom-and-bust" cycle the authors identify in many respects continues the pre-Spanish demographic regime but on an amplified scale.

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Covey, Childs, and Kippen explore indigenous Andean demographic responses to violence, disease, hardship, and mi-

gration wrought by Spanish colonial rule in the former Inka imperial heartland, an area that had already undergone demographic upheavals during Inka state formation and expansion. They address long-standing narratives of colonial-era indigenous demographic collapse in the Spanish Americas, aspects of which have become paradigmatic, owing partly to the limitations of most available colonial demographic sources and partly to a narrative of decimation—what Michael Wilcox (2009) has recently termed the "termination narrative"—that has predominated in the literature for more than a generation. Their central findings document a case of short-term population recovery after a sharp decline in the early years following the Spanish invasion; these peaks and valleys occur within an overarching downward trajectory resulting from successive intergenerational demographic stressors.

To historical demographers, the results are not unexpected but clearly show the resilience of Andean peoples to the violence, disease, and exploitation of Spanish colonial rule. Covey and colleagues analyze relationships between epidemics, mortality, and fertility, but they also move the analysis beyond anonymous epidemiological processes to enacted social ones. This perspective sheds light on how local communities responded successfully to demographic stressors over the short term but were subjected to social, economic, and political policies and structures that made population replacement untenable over the long term. Far from the inevitable outcome of the introduction of new pathogens, then, Covey and colleagues demonstrate how long-term demographic decline was (at least partly) attributable to failures of an exploitative colonial administrative system.

This is, without doubt, a productive and innovative contribution to the historical demography of the Americas, but perhaps even their reading of colonial administrative failures is too charitable to the means and ends of Spanish colonial administration, especially in the early decades under consideration here. Framed as a case study in comparative imperialism, Covey and colleagues approach the question against the trumpeted ideologies of beneficence common to colonial states and thus against an implicit counterfactual: one in which a more efficient or sensitive colonial administration would have in fact fostered more healthful and prosperous lives for native Andeans. The following two interrelated objections might thus be raised: (1) that the critique accepts too much of the ideological presuppositions of the colonial state and (2) that it assumes too much coherency to the formation, structure, and functions of colonial state apparatus in Peru.

If the latter of these observations is taken first, one of the lessons referred to in the title is that colonial administration was "not sufficiently flexible or sensitive to dynamics of demographic flux." This seems to rely on a rather abstracted, technocratic view of colonial administration. The colonial state as it developed in Peru was a hydra-like beast of conflicting interests and factions (both Spanish and indigenous) and, even after the Toledan reforms, was founded on a core compromise that more or less left indigenous community

structures intact. Again, in the abstract, better health and greater longevity for the subject population probably would have been in the interest of the colonial state over the long run, but in practice the compulsion to extract came from above—from the Crown—continuously and urgently. It is a commonplace to observe that the colonial political economy of the Peruvian viceroyalty *qua* economic system (even in all of its institutional slippage) rested fundamentally on the exploitation of indigenous labor, but it bears emphasis that its basic functioning relied on coercive measures, since most Andean communities were not alienated from their means of agricultural and pastoral production (Spalding 1982). The discovery of the great concentration of silver at Potosí created its own distortions (e.g., compared to the situation in Mexico), exacerbating undercapitalization and dependency on coerced labor, with insistent pressure for ever-increasing extraction (Garner 1988).

Outcomes detrimental to the health and longevity of the people of the *república de indios* were thus integral, not epiphenomenal, to the colonial economy as it actually functioned. Systemic labor shortfalls were increasingly filled by slave labor through the seventeenth and eighteenth centuries, even by those actors and institutions that most strenuously criticized the temporal compromises of colonial administration (the Society of Jesus was the largest slaveholder prior in the Americas before their expulsion in 1767; Cushner 1980:89).

My point is not to moralize or prescribe an anticolonialist critique but to critically evaluate the enabling rationalizations of colonialist representations and push the analysis forward on its strengths, which lie in its elucidation of the in situ effects and responses to the kind of repeated insults-to-injury pattern that Covey and colleagues document. As is, the analysis is fitted to a top-down comparative perspective that may risk reproducing some of the myths of the colonial state that it seeks to undermine. The authors' insightful analysis could serve as the basis for a complementary perspective on bottom-up, local-scale processes of community reproduction and transformation. This is surely a perspective that the authors have considered and will develop using complementary documentary and archaeological sources.

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## Reply

We appreciate our colleagues' comments, which allow us to clarify our research, to comment more broadly on implications and limitations of our study, and to identify avenues for future research. The decline of Amerindian populations after 1492 is a complex and contentious issue, constrained by a paucity of quality data, colored by centuries of ideological debate. Historical demographers know that fertility, mortality, and migration influence demographic change—several of our colleagues have previously hypothesized processes similar to

those we detail in Yucay—but as Cahill, Cook, and Livi-Bacci note, early colonial documents rarely provide sufficient detail to generate consensus regarding population counts, let alone tease out the factors underlying change over time across regions.

Cook illustrates this in his citation of census documents from sixteenth-century Peru: the 1562 Chupachu *visita* records valuable observations of household organization, but data are not consistent enough to conduct fertility analysis—this is true for population data in other early *visitas*. Cook (1981:77–78) notes that the Toledan census collected more detailed data on indigenous demography, but extant documentation—the published *tasas* (Cook 1975)—offers only coarse-grained gender and age data. Our data set predates the Toledan *reducciones* and is particularly detailed; our methods can be applied to similarly detailed population surveys recorded from later years, provided that the Yucay *yana* household data are sufficiently robust data to analyze demography, using the techniques we have employed.

Some comments address the quality of the Yucay data, focusing on (1) whether the population is sufficiently stable to be studied in this manner and (2) how the collection of *yana* households compares with other indigenous populations. Regarding the former, several colleagues (Cook, Murphy) emphasize migration, which we discuss to the extent that the documentation permits. While there are certainly ambiguities regarding migration immediately before the household survey, the view from Yucay is remarkably detailed compared with that from other parts of the Andes. We can reconstruct multiple waves of Inka-mandated migration and identify cases of Colonial-era introduction of *yanakuna* to the Yucay Valley (Covey and Elson 2007). This is impossible for other parts of the Andes at this time—one cannot presume that a lack of evidence of migration elsewhere indicates a stable population.

Like other Andean populations, the Yucay *yanakuna* were not demographically stable during the sixteenth century, but the role of long-distance migration in the decade or so before the household survey appears to be limited. This is supported by the low incidence of emigration in the years between the initial registry of *yana* households and the reconfirmation of these data by Gutiérrez Flores, as well as a tendency of younger migrants to come from nearby localities. Of 134 men born outside the Yucay Valley, 30 migrated from outside the Cusco region—of these, only seven men with children in the OCM analysis stated that they had begun their current service relationship in the previous decade. This is a very rough measure of recent immigration affecting the counts of children in the OCM analysis, but it suggests only limited continuity of long-distance migration practices known from Inka times and the first years following the European invasion. As we note, female migration cannot be directly evaluated, but there is no documented reason to expect that female migration rates varied significantly from those of males at this time.

Relating *yana* households to other populations is impor-

tant. We consider whether a collection of nontributary households can be studied as a population—not whether it is representative of demographic conditions elsewhere, an issue that concerns Cook, Livi-Bacci, and others worried that our results might be inappropriately extrapolated. Inka administrative policies transformed Andean communities, as did migration, warfare, and other disruptions in the decades following the European invasion. We note that tributary units recorded in the Toledan *tasas* reflect royal grants of income or native labor and not Inka-era communities. Additionally, the towns into which natives—including the Yucay *yanakuna*—were reduced were often agglomerations of diverse kin and ethnic constituencies that had to develop new strategies to face colonial demands. We cannot assume conditions of stable village organization for pre-*reducción* populations and should not treat Spanish tributary categories as such. The Yucay *yana* households are demographically comparable to regional categories recorded in the Toledan *tasas* from Cusco, suggesting that our data set lacks significant anomalies with broader demographic conditions. From this we suggest that it is reasonable to treat this sample as a population for demographic analysis.

*Yanakuna* experienced Inka and Spanish rule differently from tributary populations, however, and Newson offers perspectives on comparing these groups. In Cusco, *yanakuna* were dislocated from their natal communities and depended on the fortunes of elite patrons for protection. They received certain material support from masters and mistresses but labored to serve them for longer periods than tributary populations, including service on lowland coca plots that highlanders considered particularly unhealthy work. *Yanakuna* had access to the best agricultural lands in the Inka heartland but only through service within an elite hierarchy that fluctuated significantly—one's subsistence resources could be disrupted suddenly as land ownership or use patterns changed. Overall, it seems that benefits of retainership outweighed the negatives in the first decades of Spanish rule, given the commitment of *yanakuna* to remaining in the Cusco region under that status.

From the sample of Yucay *yana* households, we turn to some questions and comments regarding the methods and interpretation of the sample. Livi-Bacci cautions about smoothing age data; while we acknowledge the risk in oversmoothing data, pronounced age heaping necessitated some adjustments to make sense of the data. For example, there were 40 men and 66 women recorded at age 40 years and none recorded at age 41 years. We have used Karup-King multipliers, an established method, to correct the age profile before analysis, and we include unadjusted data in the paper.

In Joralemon's estimation (cf. Livi-Bacci) the high level of fertility we document "strains credibility." However, contemporary national-level TFRs are not the most appropriate comparison for the simple reason that contraceptives are widely available, even in Niger, where 70% of women know of at least one modern method (INS and Macro International 2007). Furthermore, we hypothesize that the highest TFRs revealed in our

analysis reflect what demographers term "recovery fertility": a fertility spike occurring after famines or other disasters (Bongaarts and Cain 1982; Lee 1997; Peng 1987). Our analysis implies that, after recovery, fertility stabilized around eight births per woman—roughly Niger's rural TFR in 1998 before contraception became more widespread (Attama et al. 1998) but still below the highest recorded fertility rates. Among the early generation of French pioneer women born in Canada, those who married between ages 15 and 19 gave birth, on average, to 11.4 children (Livi-Bacci 1997:65). Fertility among North America's Dariusleut Hutterites hovered near 10 births per woman in the early twentieth century and did not drop below eight until after 1970 (Nonaka, Miura, and Peter 1994). It is not unreasonable to find a TFR near eight births per woman in a society where marriage is early and universal, birth control is not practiced, and average birth intervals are reduced by high infant mortality.

Some comments (Livi-Bacci, McCaa) suggest that mean household size is small for a high-fertility population, and McCaa proposes that child marriage practices might contribute to this phenomenon. Our data indicate that marriage often occurred before the age of childbearing—of 42 households where the husband was still in his teens, only 24% ( $n = 10$ ) listed children (these and the following figures were calculated with unsmoothed data). The high incidence of widowhood also lowers mean household size. Individuals living alone represent 28% of all households, and married couples were found in only 55% of households. Single-parent households had much higher mean ages for surviving parents—for example, widows with one child ( $n = 70$ ) had an average age of 50, while married women with one child ( $n = 110$ ) had an average age of 33. Such households were generally not growing at the time of the census and are less likely to be represented in the sample selected for OCM analysis. Mean household size for all families with children aged 10 and under was 3.98, about 50% higher than the average for the overall Yucay sample.

Two hundred fourteen households consisted of a woman living alone (mean age, 55), and the large proportion of older women is one feature of the demographic profile that we have considered in our discussion. We suggest that this may be an artifact of demographic stresses (increased male mortality rates) or changing marriage patterns, encouraging second wives or widows to seek security as retainers. Since these older women contribute strongly to a sex ratio also observed in Cusco region tributary populations, the latter may be implausible, although it is impossible to determine the proportion of older women in other populations.

Another demographic pattern in the Yucay sample is the small cohort of 10–14 year olds. Because epidemics of influenza and hemorrhagic smallpox occurred in the Andes at this time (Cook 1981:60), we suggest that in the late 1550s epidemic disease and associated social disruptions reduced fertility and exercised disproportionately high morbidity on infants and young children. Livi-Bacci emphasizes the likelihood of reduced fertility as a contributing factor to this particular

demographic disruption. Observing that some diseases kill without regard for age (but see Hill 1991), Joralemon suggests that the pattern can be explained by reduced fertility derived from nonlocal service requirements of male *yanakuna*. We are reluctant to blame a particular disease for the diminished cohort, but we do not find evidence of major changes in military or coca service requirements for the Yucaj *yanakuna* at this time. The latter occurred in the early 1550s—after the last major Spanish rebellions—with royal assumption of administration of the Yucaj Valley and an increased focus on coca production (Covey and Elson 2007:308ff.). The late 1550s did see major resource reallocations in the valley, including the grant of the valley to the Inka Sayre Tupa. These could have contributed to food insecurity and social disruption.

Regarding the broader implications of our interpretations, some comments (Wernke, McCaa) voice concern that this study downplays the abuses of the Spanish colonial system. Our colleagues raise some pertinent issues regarding myths of state and empire and how they can permeate the interpretation of imperialism. Our study was not designed to evaluate how rapacious, intolerant, and racist the early modern Spanish empire was but rather to assert that (1) indigenous demographic decline involved local disaster events that were followed by recovery and (2) local inability to maintain population over the long term could be influenced by macro-demographic cycles and the failure of the colonial administrative record keeping to identify and confront them. We promote a dynamic approach that considers both indigenous resilience and colonial structural flaws.

Imperial myths suffuse the vigorous sixteenth-century debate over the issue of “good government” and Spanish empire. Apologists for native empire fantasized about Inka benevolence in the interest of indigenous rights, while proponents of direct Spanish rule cited racist theories of native inferiority and allegations of Inka tyranny to buttress their arguments. Cusco is an ideal region to dispense with the myth of benevolent state expansion. The Inkas conquered many neighboring groups by force, bullied friends and allies, and forcibly resettled many local populations in unstable peripheral regions. Inka nobles expropriated land and labor to develop royal estates, staffing their private properties with people who were permanently dislocated from functioning provincial communities—the Yucaj *yanakuna* are the best known of these subordinated populations. Newson argues that the demographic regime described for early Colonial Yucaj represents continuity from Inka-era conditions, so we should consider that rural populations of the Cusco region on the eve of the European invasion had already experienced generations of state-imposed disequilibrium, part of broader conditions of social and economic disruption accompanying the spread and consolidation of Inka imperial power.

The emerging Spanish imperial model was arguably more steeped in cruelty, racism, and intolerance. While many Spaniards decried the deadly exploitation of Amerindian populations, the Aristotelian subtext of the debate reflects, at best,

a paternalistic stance toward natives but more frequently a pronounced assumption of moral, intellectual, and physical inferiority. Our study leaves insufficient room for a full critical treatment of the litany of abuses that accompanied Spanish empire in the Americas. We argue that demographic recovery in the face of new epidemics and imperial disruptions accentuates the resilience of the population in question, but we also acknowledge that such recovery occurred under specific local conditions and within a context of overall decline. As Wernke observes, Spanish empire rested on a foundation of compulsive and coercive extraction. With emphasis on output measured in silver rather than the well-being of the workforce used to achieve it, colonial officials gave low priority to the kind of regular population assessments and tributary reassessments that were conducted in the Andes in Inka times (to enable the Inkas to extract coercively). Our focus on the structural cruelty of Spanish imperial practices at this time is not intended to excuse individual agents of empire from culpability.

More dynamic perspectives on indigenous demographic decline will emerge through the development of local trajectories based on solid multidisciplinary data. We agree with Cahill, Livi-Bacci, and Newson that more case studies are needed for comparison with the Yucaj example and to evaluate our hypotheses regarding large-scale and long-term change. Some census data from the late sixteenth and seventeenth centuries may provide sufficient detail to conduct fertility analysis in communities following the Toledan *reducciones* and during the protracted failure of policies aimed at administrative consolidation. Complementing local census data, Cahill draws attention to the need to bring parish documents and the records of religious orders into discussions of the colonial experiences of indigenous populations. Religious institutions and local clergy were imperial auxiliaries that should be accounted for. In recent decades, archaeology (particularly bioarchaeology) has come to make greater contributions to understanding the contact and Colonial Period in the Americas, and we join Cahill and Murphy in anticipating a time in the future when archaeology offers an independent database for the Cusco region that includes fine-grained settlement chronologies and robust mortuary samples. As McCaa argues, the material record may ultimately be the source of definitive evidence of some of the forces driving processes of decline.

—R. Alan Covey, Geoff Childs, and Rebecca Kippen

## References Cited

- Acosta, José de. 1940 [1590]. *Historia natural y moral de las Indias*. Edmundo O’Gorman, ed. Mexico City: Fondo de Cultura Económica.
- Andrushko, Valerie. 2007. The bioarchaeology of Inca imperialism in the heartland: an analysis of prehistoric burials from the Cuzco



- region of Peru. PhD dissertation, University of California, Santa Barbara. [MSM]
- Assadourian, Carlos Sempat. 1994. La gran vejación y destrucción de la tierra: las guerras de sucesión y de conquista en el derrumbe de la población indígena del Perú. In *Transiciones hacia el sistema colonial andino*. Pp. 19–62. Lima: Instituto de Estudios Peruanos. [RM]
- Attama, Sabine, Michka Seroussi, Alichina Idrissa Kourguéni, Harouna Koché, and Bernard Barrém. 1998. *Enquête démographique et de santé, Niger 1998*. Calverton, MD: Care International/Niger and Macro International.
- Austin Alchon, Suzanne. 1991. *Native society and disease in colonial Ecuador*. New York: Cambridge University Press. [NDC]
- . 2003. *A pest in the land: New World epidemics in a global perspective*. Albuquerque: University of New Mexico Press. [NDC]
- Baker, Brenda, and Lisa Kealhofer, eds. 1996. *Bioarchaeology of Native American adaptation in the Spanish borderlands*. Gainesville: University Press of Florida. [MSM]
- Bocquet-Appel, Jean-Pierre, ed. 2008. *Recent advances in palaeodemography: data, techniques, patterns*. Dordrecht: Springer. [MSM]
- Bogue, Donald J., Eduardo E. Arriaga, and Douglas L. Anderton, eds. 1993. *Readings in population research methodology*. Chicago: Social Development Center.
- Boldsen, Jesper L., George R. Milner, Lyle Konigsberg, and James Wood. 2002. Transition analysis: a new method for estimating age from skeletons. In *Paleodemography: age distributions from skeletal samples*. Robert Hoppa and James Vaupel, eds. Pp. 73–106. Cambridge: Cambridge University Press. [MSM]
- Bonds, Matthew H., Donald C. Keenan, Pejman Rohani, and Jeffrey D. Sachs. 2010. Poverty trap formed by the ecology of infectious diseases. *Proceedings of the Royal Society B* 277(1685):1185–1192.
- Bongaarts, John, and Mead Cain. 1982. Demographic responses to famine. In *Famine*. Kevin Cahill, ed. Pp. 44–62. New York: Orbis.
- Boyle, Phelim P., and Cormac O'Gráda. 1986. Fertility trends, excess mortality, and the Great Irish Famine. *Demography* 23:543–562.
- Buikstra, Jane, George R. Milner, and Jesper L. Boldsen. 2006. Janaab' Pakal: the age-at-death controversy revisited. In *Reconstructing the life and death of a Maya ruler*. Vera Tiesler and Andrea Cucina, eds. Pp. 103–122. Tucson: University of Arizona Press. [MSM]
- Burnet, F. M., and D. O. White. 1972. *Natural history of infectious disease*. Cambridge: Cambridge University Press.
- Carrasco, Pedro. 1964. Tres libros de tributos del Museo Nacional de México y su importancia para los estudios demográficos. In *XXXV Congreso Internacional de Americanistas, México, 1962, Actas y Memorias*. Pp. 373–379. Mexico City. [RM]
- Childs, Geoff. 2003. Polyandry and population growth in a historical Tibetan society. *History of the Family* 8(3):423–444.
- Cho, Lee-Jay, Robert D. Retherford, and Minja Kim Choe. 1986. *The own-children method of fertility estimation*. Honolulu: East-West Center.
- Cieza de León, Pedro de. 1986 [1553]. *Crónica del Perú, primera parte*. 2nd edition. Lima: Pontificia Universidad Católica del Perú.
- Coale, Ansley J., and Paul Demeny. 1983. *Regional model life tables and stable populations*. New York: Academic Press.
- Cook, Noble David, ed. 1975. *Tasa de la visita general de Francisco de Toledo*. Lima: Universidad Nacional Mayor de San Marcos.
- . 1981. *Demographic collapse: Indian Peru, 1520–1620*. New York: Cambridge University Press.
- . 1982a. *People of the Colca Valley: a population study*. Boulder, CO: Westview. [NDC]
- . 1982b. Population data for Indian Peru: sixteenth and seventeenth centuries. *Hispanic American Historical Review* 62(1):73–120.
- . 1990. Migration in colonial Peru: an overview. In *Migration in colonial Spanish America*. David J. Robinson, ed. Pp. 41–61. New York: Cambridge University Press.
- . 1998. *Born to die: disease and New World conquest, 1492–1650*. New York: Cambridge University Press.
- . 2002a. Avances en el estudio de la población andina colonial. *Histórica* 26(1–2):15–84. [NDC]
- . 2002b. Sickness, starvation, and death in early Hispaniola. *Journal of Interdisciplinary History* 32(3):349–386.
- . 2005. *La conquista biológica: las enfermedades en el Nuevo Mundo*. 2nd edition. Madrid: Siglo XXI Editores. [NDC]
- . 2010. *La catástrofe demográfica andina: Perú, 1520–1620*. 2nd edition. Lima: Pontificia Universidad Católica del Perú. [NDC]
- Cook, Noble David, with Alexandra Parma Cook. 2007. *People of the volcano: Andean counterpoint in the Colca Valley, Peru*. Durham, NC: Duke University Press. [NDC]
- Cook, Noble David, and W. George Lovell. 1991. “Secret judgments of God”: Old World disease in colonial Spanish America. Norman: University of Oklahoma Press.
- Covey, R. Alan. 2006. *How the Incas built their heartland: state formation and the innovation of imperial strategies in the Sacred Valley, Peru*. Ann Arbor: University of Michigan Press.
- . 2008. Imperial transformations in the Yucay Valley in the fifteenth and sixteenth centuries. In *Imperial transformations in sixteenth-century Yucay, Peru*. R. Alan Covey and Donato Amado González, eds. Pp. 18–29. *Memoirs of the Museum of Anthropology* 44. Ann Arbor: University of Michigan.
- Covey, R. Alan, and Christina M. Elson. 2007. Ethnicity, demography, and estate management in sixteenth-century Yucay (Cusco, Peru). *Ethnohistory* 54(2):303–335.
- Covey, R. Alan, and Donato Amado González, eds. 2008a. *Imperial transformations in sixteenth-century Yucay, Peru*. Ann Arbor: *Memoirs of the Museum of Anthropology* 44. Ann Arbor: University of Michigan.
- . 2008b. The Marquisate of Oropesa and the preservation, collection, and study of its documents. In *Imperial transformations in sixteenth-century Yucay, Peru*. R. Alan Covey and Donato Amado González, eds. Pp. 30–32. *Memoirs of the Museum of Anthropology* 44. Ann Arbor: University of Michigan.
- Crosby, Alfred W. 1976. Virgin soil epidemics as a factor in the Aboriginal depopulation in America. *William and Mary Quarterly* 33(2):289–299.
- . 1992. Summary on population size before and after contact. In *Disease and demography in the Americas*. John W. Verano and Douglas H. Ubelaker, eds. Pp. 277–278. Washington, DC: Smithsonian Institution.
- Cushner, N. P. 1980. *Lords of the land: sugar, wine, and Jesuit estates of coastal Peru, 1600–1767*. Albany: State University of New York Press. [SAW]
- deFrance, Susan D. 1996. Iberian foodways in the Moquegua and Torata valleys of southern Peru. *Historical Archaeology* 30(3):20–48.
- . 2003. Diet and provisioning in the High Andes: a Spanish colonial settlement on the outskirts of Potosí, Bolivia. *International Journal of Historical Archaeology* 7(2):99–125.
- Denevan, William M., ed. 1992. *The Native population of the Americas in 1492*. 2nd edition. Madison: University of Wisconsin Press.
- de Waal, Alex. 1989. Famine mortality: a case study of Darfur, Sudan 1984–5. *Population Studies* 43:5–24.
- Dobyns, Henry F. 1993. Disease transfer at contact. *Annual Review of Anthropology* 22:273–291.
- Dyson, Tim. 1991. On the demography of South Asian famines. I, II. *Population Studies* 45:5–25, 279–297.
- Enríquez, Martín. 1921 [1583]. Relación hecha por el Virrey D. Martín Enríquez de los oficios que se proveen en la gobernación de los reinos y provincias del Perú (1583). In *Gobernantes del Perú: Cartas y papeles: Siglo XVI: Documentos del Archivo de Indias*, tomo

- IX. Roberto Levillier, ed. Pp. 114–230. Madrid: Sucesores de Rivadeneyra.
- Flannery, Kent V., Joyce Marcus, and Robert G. Reynolds. 1989. *Flocks of the Wamani: a study of llama herders in the Punas of Ayacucho, Peru*. New York: Academic Press.
- Garcilaso de la Vega, “El Inca.” 1965 [1609]. Los comentarios reales de los incas. In *Obras completas*. Sáenz de Santa María, Carmelo, ed. Pp. 132–135. Biblioteca de Autores Españoles. Madrid: Ediciones Atlas.
- Garner, R. L. 1988. Long-term silver mining trends in Spanish America: a comparative analysis of Peru and Mexico. *American Historical Review* 93:898–935. [SAW]
- Hadden, Gordon J. 1967. Un ensayo de demografía histórica y etnológica en Huánuco. In *Visita de la provincia de León de Huánuco en 1562, Inigo Ortiz de Zúñiga, visitador. I. Visita de las cuatro waranqa de los Chupachu*. John V. Murra, ed. Pp. 369–380. Huánuco, Peru: Universidad Nacional Hermilio Valdizán.
- Haines, Michael R. 1989. American fertility in transition: new estimates of birth rates in the United States, 1900–1910. *Demography* 26(1):137–148.
- Hajnal, John. 1953. Age at marriage and proportions marrying. *Population Studies* 7:111–136. [RM]
- Hanke, Lewis. 2002. *The Spanish struggle for justice in the conquest of America*. Dallas: Southern Methodist University Press.
- Hemming, John. 1970. *The conquest of the Incas*. New York: Harcourt, Brace, Jovanovich.
- Henige, David P. 1998. *Numbers from nowhere: the American Indian contact population debate*. Norman: University of Oklahoma Press.
- Hill, Kenneth. 1991. *Demographic response to economic shock*. Working paper 652. Washington, DC: World Bank.
- Hoppa, Robert D., and James W. Vaupel, eds. 2002. *Paleodemography: age distributions from skeletal samples*. Cambridge: Cambridge University Press. [MSM]
- INS (Institut National de la Statistique) and Macro International. 2007. *Enquête démographique et de santé et à indicateurs multiples du Niger 2006*. Calverton, MD: INS and Macro International.
- Jamieson, Ross W. 2000. *Domestic architecture and power: the historical archaeology of colonial Ecuador*. New York: Kluwer Academic/Plenum.
- Jones, David S. 2003. Virgin soils revisited. *William and Mary Quarterly* 60(4):703–742.
- Joralemon, Donald. 1982. New World depopulation and the case of disease. *Journal of Anthropological Research* 38(1):108–127.
- Kipling, Rudyard. 1922 [1899]. The white man’s burden. In *Rudyard Kipling’s verse, inclusive edition, 1885–1918*. Pp. 371–372. Garden City, NJ: Doubleday & Page.
- Klaus, Haagen D., and Manuel E. Tam. 2009. Contact in the Andes: bioarchaeology of systemic stress in colonial Mórrope, Peru. *American Journal of Physical Anthropology* 138:356–368. [MSM]
- Konigsberg, Lyle, and Susan Frankenberg. 2002. Deconstructing death in paleodemography. *American Journal of Physical Anthropology* 117:297–309. [MSM]
- Kuznesof, Elizabeth. 1998. Marriage and family life in Andean indigenous communities, 16th to 18th centuries. In *Cambios demográficos en América Latina: la experiencia de cinco siglos*. Dora Celton, Carmen Miró, and Nicolás Sánchez Albornoz, eds. Pp. 157–180. Liege, Belgium/Córdoba, Argentina: International Union for the Scientific Study of Population/Universidad Nacional de Córdoba. [RM]
- Larsen, Clark Spencer. 1994. In the wake of Columbus: native population biology in the postcontact Americas. *American Journal of Physical Anthropology* 37(S19):109–154.
- Larsen, Clark Spencer, Alfred W. Crosby, Mark C. Griffin, Dale L. Hutchinson, Christopher B. Ruff, Katherine F. Russell, Margaret J. Schoeninger, et al. 2002. A biohistory of the Georgia bight: the agricultural transition and the impact of European contact. In *The backbone of history: health and nutrition in the Western Hemisphere*. Richard Steckel and Jerome C. Rose, eds. Pp. 406–439. New York: Cambridge University Press. [MSM]
- Larsen, Clark Spencer, Mark C. Griffin, Dale L. Hutchinson, Vivian E. Noble, Lynn Norr, Robert F. Pastor, Christopher B. Ruff, et al. 2001. Frontiers of contact: bioarchaeology of Spanish Florida. *Journal of World Prehistory* 15:69–123. [MSM]
- Larsen, Clark Spencer, and George R. Milner, eds. 1994. *In the wake of contact*. New York: Wiley-Liss. [MSM]
- las Casas, Bartolomé de. 1875 [1552–1562]. *Historia de las Indias*, tomo III. Madrid: Imprenta de Miguel Ginesta.
- Lee, R. D. 1997. Population dynamics: equilibrium, disequilibrium, and consequences of fluctuations. In *Handbook of population and family economics*. M. R. Rosenzweig and O. Stark, eds. Pp. 1063–1115. Amsterdam: Elsevier Science.
- Livi-Bacci, Massimo. 1997. *A concise history of world population*. Malden, MA: Blackwell.
- . 2001. Demographic shocks: the view from history. In *Seismic shifts: the economic impact of demographic change*. Jane Sneddon Little and Robert K. Triest, eds. Pp. 43–66. Federal Reserve Bank of Boston Conference Series 46. Boston: Federal Reserve Bank.
- . 2003. Returning to Hispaniola: reassessing a demographic catastrophe. *Hispanic American Historical Review* 83(1):3–51.
- . 2006. *Los estragos de la conquista: Quebranto y declive de los indios de América*. Barcelona: Crítica. [NDC]
- . 2008. *Conquest: the destruction of the American Indians*. Malden, MA: Polity. [RM]
- López de Gómara, Francisco. 1922 [1552]. *Historia general de las Indias*, 2 vols. Madrid: Calpe.
- López de Velasco, Juan. 1971 [1574]. *Geografía y descripción universal de las Indias*. Biblioteca de Autores Españoles 248. Madrid: Ediciones Atlas.
- Lovell, W. George. 1992. “Heavy shadows and black night”: disease and depopulation in colonial Spanish America. *Annals of the Association of American Geographers* 82(3):426–443.
- Lovell, W. George, and Christopher Lutz. 1995. *Demography and empire: a guide to the population history of Spanish Central America, 1520–1821*. Boulder, CO: Westview.
- Macintyre, Kate. 2002. Famine and the female mortality advantage. In *Famine demography: perspectives from the past and present*. Tim Dyson and Cormac O’Grada, eds. Pp. 240–259. New York: Oxford University Press.
- Martí Carvajal, Armando J. 2002. Sobre la población aborigen de Boriquén (Puerto Rico). *Revista de Indias* 62(225):495–510.
- McCaa, Robert. 1996. Matrimonio infantil, “cemithualtin” (familias complejas) y el antiguo pueblo nahua. *Historia Mexicana* 46:3–70. [RM]
- . 2002. Paleodemography of the Americas. In *The backbone of history: health and nutrition in the Western Hemisphere*. Richard Steckel and Jerome Rose, eds. Pp. 94–124. New York: Cambridge University Press. [MSM]
- McCaa, Robert, Aleta Nimlos, and Teodoro Hampe-Martínez. 2004. *Why blame smallpox? the death of the Inca Huayna Capac and the demographic destruction of Tawantinsuyu (ancient Peru)*. <http://www.hist.umn.edu/~rmccaa/aha2004>. [RM]
- Milner, George R. 1996. Prospects and problems in contact-era research. In *Bioarchaeology of Native American adaptation in the Spanish Borderlands*. Brenda Baker and Lisa Kealhofer, eds. Pp. 198–208. Gainesville: University Press of Florida. [MSM]
- Milner, George R., James Wood, and Jesper L. Boldsen. 2008. Paleodemography. In *Biological anthropology of the human skeleton*. M. Anne Katzenberg and Shelley Saunders, eds. Pp. 561–600. New York: Wiley-Liss. [MSM]
- Newson, Linda. 1986. *The cost of conquest: Indian decline in Honduras under Spanish rule*. Boulder, CO: Westview. [NDC]

- . 1987. *Indian survival in colonial Nicaragua*. Norman: University of Oklahoma Press. [NDC]
- . 1995. *Life and death in early Colonial Ecuador*. Norman: University of Oklahoma Press. [NDC]
- . 2003. Patterns of Indian depopulation in early Colonial Ecuador. *Revista de Indias* 63(227):135–156.
- Nonaka, K., T. Miura, and K. Peter. 1994. Recent fertility decline among the Dariusleur Hutterites: an extension of Eaton and Mayer's Hutterite fertility study. *Human Biology* 66(3):411–420.
- Ondegardo, Polo de. 1917 [1571]. Del linaje de los Ingas y como conquistaron. *Colección de Libros y Documentos Referentes a la Historia del Perú*, ser. I, vol. 4. Pp. 45–94. Lima: Sanmartí.
- Ortiz de Zúñiga, Inigo. 1967–1972. *Visita de la provincia de León de Huánuco en 1562*, 2 vols. John V. Murra, ed. Lima: P. L. Villanueva. [NDC]
- Palmer, James A., and Robert W. Gardner. 1994. *Measuring mortality, fertility, and natural increase: a self-teaching guide to elementary measures*. Honolulu: East-West Center.
- Pease, Franklin, ed. 1977. *Collaguas I*. Lima: Fondo Editorial de la Pontificia Universidad Católica del Perú. [NDC]
- Peng, Xizhe. 1987. Demographic consequences of the Great Leap Forward in China's provinces. *Population and Development Review* 13(4):639–670.
- Peterson, William. 1975. A demographer's view of prehistoric demography. *Current Anthropology* 16(2):227–245.
- Polo, José Toribio. 1913. Apuntes sobre las epidemias del Perú. *Revista Histórica* 5:50–109.
- Poma de Ayala, Guaman. 2004 [1615]. *Nueva crónica y buen gobierno*. Copenhagen: Det Kongelige Bibliotek. John Murra, Jorge Urioste, and Rolena Adorno, trans. <http://www.kb.dk/permalink/2006/poma/info/es/frontpage.htm>. [RM]
- Powers, Karen Vieira. 1995. *Andean journeys: migration, ethnogenesis, and the state in colonial Quito*. Albuquerque: University of New Mexico Press.
- Rabell, Cecilia A., and Carlos S. Assadourian. 1977. Self-regulating mechanisms of the population in a pre-Columbian society: the case of the Inka empire. *International Population Conference* 3:25–42. Liège: Derouaux. [LAN]
- Ramirez-Horton, Susan. 1978. Chérrepe en 1572: un análisis de la visita general del Virrey Francisco de Toledo. *Historia y Cultura* 11:79–121.
- Retherford, Robert D., Lee-Jay Cho, and Nam-Il Kim. 1984. Census-derived estimates of fertility by duration of first marriage in the Republic of Korea. *Demography* 21(4):537–558.
- Retherford, Robert D., and Shyam Thapa. 1998. Fertility trends in Nepal, 1977–1995. Special issue, *Contributions to Nepalese Studies: Fertility Transition in Nepal* 25:9–58.
- Robinson, David J., ed. 2002. *Collaguas II: Lari Collaguas: economía, sociedad y población, 1604–1605*. Lima: Fondo Editorial de la Pontificia Universidad Católica del Perú. [NDC]
- , ed. 2006. *Collaguas III: Yanque Collaguas: sociedad, economía y población, 1604–1617*. Lima: Fondo Editorial de la Pontificia Universidad Católica del Perú. [NDC]
- Rostworowski, María, and Isabel Remy, eds. 1992. *Las visitas a Cajamarca 1571–72/1578*, 2 vols. Lima: Instituto de Estudios Peruanos. [NDC]
- Rostworowski de Diez Canseco, María. 1983–1984. La tasa ordenada por el Licenciado Pedro de la Gasca (1549). *Revista Histórica* 34: 53–102.
- Rowland, Donald T. 2003. *Demographic methods and concepts*. Oxford: Oxford University Press.
- Salomon, Frank. 1986. *Native lords of Quito in the age of the Incas: the political economy of north Andean chiefdoms*. New York: Cambridge University Press. [LAN]
- Schroeder, Robert, and Robert D. Retherford. 1979. Application of the own-children method of fertility estimation to an anthropological census of a Nepalese village. *Demography India* 8(1–2):247–256.
- Spalding, K. 1982. Exploitation as an economic system: the state and the extraction of surplus in colonial Peru. In *The Inca and Aztec states, 1400–1800: anthropology and history*. G. A. Collier, R. Rosaldo, and J. D. Wirth, eds. Pp. 321–342. New York: Academic Press. [SAW]
- Stavig, Ward. 1999. *The world of Túpac Amaru: conflict, community, and identity in colonial Peru*. Lincoln: University of Nebraska Press.
- Steckel, Richard H., and Jerome C. Rose, eds. 2002. *The backbone of history: health and nutrition in the Western Hemisphere*. New York: Cambridge University Press.
- Thornton, Russell. 1997. Aboriginal North American population and rates of decline, ca. AD 1500–1900. *Current Anthropology* 38(2): 310–315.
- Toledo, Francisco de. 1867 [1572]. Ordenanzas que el Señor Viso Rey Don Francisco de Toledo hizo para el buen gobierno de estos Reynos del Perú y Repúblicas de él. *Relaciones de los vireyes y audiencias que han gobernado el Perú. I. memorial y ordenanzas de D. Francisco de Toledo*. Pp. 33–154. Lima: J. E. Campo.
- UN Population Division. 2009. *World population prospects: the 2008 revision*. New York: UN Department of Economic and Social Affairs. <http://esa.un.org/unpd/wpp2008/index.htm>. [DJ]
- Varón Gabai, Rafael. 1997. *Francisco Pizarro and his brothers: the illusion of power in sixteenth-century Peru*. Javier Flores Espinosa, trans. Norman: University of Oklahoma Press.
- Verano, John W. 2003. Human skeletal remains from Machu Picchu: a reexamination of the Yale Peabody Museum's Collections. In *The 1912 Yale Peruvian scientific expedition collections from Machu Picchu human and animal remains*. Richard L. Burger and Lucy D. Salazar, eds. Pp. 65–118. New Haven: Yale University Press. [MSM]
- Villanueva Urteaga, Horacio H. 1970. Documentos sobre Yucay en el siglo xvi. *Revista del Archivo Histórico del Cuzco* 13:1–148.
- Wernke, Steven A., and Thomas M. Whitmore. 2009. Agriculture and inequality in the colonial Andes: a simulation of production and consumption using administrative documents. *Human Ecology* 37:421–440.
- Whitmore, Thomas M. 1992. *Disease and death in early Colonial Mexico: simulating Amerindian depopulation*. Boulder, CO: Westview.
- Wightman, Ann M. 1990. *Indigenous migration and social change: the Forasteros of Cuzco, 1520–1720*. Durham, NC: Duke University Press.
- Wilcox, M. 2009. *The Pueblo Revolt and the mythology of conquest: an indigenous archaeology of contact*. Berkeley: University of California Press. [SAW]
- Young, Helen, and Susanne Jaspars. 1995. Nutrition, disease, and death in times of famine. *Disasters* 19(2):94–109.