



Late Prehistoric High-Altitude Hunter-Gatherer Residential Occupations in the Argentine Southern Andes

Christopher Morgan, Gustavo Neme, Nuria Sugrañes, Laura Salgan, Adolfo F. Gil, Clara Otaola, Miguel Giardina & Carina Llano

To cite this article: Christopher Morgan, Gustavo Neme, Nuria Sugrañes, Laura Salgan, Adolfo F. Gil, Clara Otaola, Miguel Giardina & Carina Llano (2017): Late Prehistoric High-Altitude Hunter-Gatherer Residential Occupations in the Argentine Southern Andes, Journal of Field Archaeology, DOI: [10.1080/00934690.2017.1308749](https://doi.org/10.1080/00934690.2017.1308749)

To link to this article: <http://dx.doi.org/10.1080/00934690.2017.1308749>



Published online: 17 Apr 2017.



Submit your article to this journal [↗](#)



View related articles [↗](#)



View Crossmark data [↗](#)



Late Prehistoric High-Altitude Hunter-Gatherer Residential Occupations in the Argentine Southern Andes

Christopher Morgan^a, Gustavo Neme^b, Nuria Sagrañes^b, Laura Salgan^b, Adolfo F. Gil^b, Clara Otaola^b, Miguel Giardina^b and Carina Llano^c

^aDepartment of Anthropology, University of Nevada, Reno, USA; ^bSan Rafael Natural History Museum, Ciudad de Mendoza, Argentina; ^cCuyo National University, Ciudad de Mendoza, Argentina

ABSTRACT

Test excavations were conducted at Risco de los Indios (RDLI), a site at 2480 masl with 29 residential features and a well-developed midden containing abundant floral, faunal, lithic, and ceramic materials. Analyses indicate the site was intensively used CA. 500 CAL B.P. as a residential base for groups focused on hunting guanaco, supplemented by locally-available wild flora and fauna as well as domestic beans transported from the lowlands. Ceramic and obsidian artifacts indicate these groups were highly mobile and in contact with groups on the eastern and western margins of the Andes. These patterns compare favorably to those seen in the region's other high altitude villages. It appears that the development of these patterns began with population increase and economic intensification in the lowlands CA. 2000 CAL B.P. and that the move to slightly lower elevation settings like RDLI may have been conditioned by the onset of the Little Ice Age.

KEYWORDS

High altitude; hunter gatherer; Andes; residential; Late Prehistoric

Introduction

The subject of human use and occupation of high altitudes in general is critical to our conception of the economic, social, and even ideological pressures and incentives that led lowland populations to move into, intensively exploit, and eventually permanently reside in marginal alpine and subalpine environments (Aldenderfer 2006; Bettinger 1996; Brantingham 2006). This topic also plays an important role in our understanding of human adaptations to high latitude, altitude's ecological analog (Innes 1991; Mäkinen 2007; Zhu et al. 2004). Understanding high altitude adaptations plays a significant role in how we perceive worldwide human dispersals and distributions across most of the planet (Dennell 2004; Klein 2008; Lahr and Foley 1994). The subject is important because high altitudes, due to the fact that they are often remote and difficult to access, are often left out of our reconstructions of past settlement systems and consequently many regional culture-historical explanatory packages (Bender and Wright 1988; Morgan et al. 2014a; Wright et al. 1980).

Here, we report on test excavations at a site situated at 2480 masl in the southeastern Argentine Andes known to local herders (*Puesteros*) as "Risco de los Indios" (RDLI), which translates as "Crag of the Indians," no doubt in reference to the site's setting at the base of a very distinctive, nearly bone-white dacite cliff. The site is a large residential locus with at least 29 stacked rock structures and a deep, well developed midden indicative of intensive, multi-family (and/or repeated) occupations. Though the site is not at a very high elevation for the Andes, it is at the elevation where hypoxia has its first effects (Beall 2001; Simonson 2015), biotic productivity is diminished, and seasonal changes are more pronounced than in lowland settings (Benedict 2007; Hevly 1983; Neme 2016), and there is considerable variability in weather and environmental productivity. This results in

markedly more risk and uncertainty than in the lowlands with regard to foraging, hunting, and other decision-making processes associated with the success or failure of different behavioral strategies (Bordley and LiCalzi 2000; Morgan 2009). The site is also one of only three other known high altitude settlements in the region, all of which have been previously excavated. Comparison of the data from these sites to RDLI allows us to identify general trends in southern Andean high altitude residential occupations in regional culture-historical and ecological contexts. From these comparisons, we develop a hypothesis regarding the cause of intensified high altitude occupations that relies more on demographic and economic explanations than on climatic or environmental ones.

Archaeological Background

The trajectory of human occupation of the high Andes mirrors that seen in many of the world's mountain ranges in that the earliest occupations appear to be mainly transhumant while later occupations appear larger, more settled, and more intensive (Aldenderfer 1998, 1999, 2006; Moore 1998; Rick 1980, 1988). The earliest evidence for human occupation of the Andes in the southern Mendoza region of Argentina is at CA. 9000 B.P. at sites like Arroyo Malo 3 and Gruta el Mallín (Dieguez and Neme 2003; Neme 2007), but these occupations appear to have been mainly sporadic and constrained to elevations below about 2500 masl (Cornejo and Sanhueza 2003; Gambier 1979, 1985; Neme and Gil 2008). It appears the high southern Andes were nearly abandoned in the middle Holocene, likely due to deteriorating environmental conditions (Zárate et al. 2005, 2010). But in the 1970s, Humberto Lagiglia initiated the first high altitude work in the region by recording and test excavating El

Indígena, a village containing 136 structures at 3400 masl on a mountain pass only CA. 14 km southwest of RDLI (Lagiglia 1997; Lagiglia et al. 1994). More recent work at the site indicates that between 1600 and 700 CAL B.P. it was geared mainly towards camelid hunting by extremely mobile hunter-gatherer groups who interacted with other foragers and farmers on both the Argentine and Chilean sides of the Andes (Neme 2016).

Since Lagiglia's pioneering work, two additional village site complexes have been identified: Los Peuquenes and Laguna el Diamante. Los Peuquenes is the smaller and lower of the two, with nine structures at 3100 masl. The Laguna el Diamante locality contains 60 structures and is situated at 3300 masl; it also has produced the oldest radiocarbon date (2100 ± 70 B.P.) for a high altitude village in the southern Andes (Durán et al. 2006). Material recovered from each of these sites indicates patterns similar to those identified at El Indígena: high elevation; proximity to mountain passes; multiple domiciles; a focus on camelid hunting; a subsidiary subsistence focus on transporting and processing wild and domestic plants, including the common bean (*Phaseolus vulgaris*); and use and curation of extralocal obsidian and ceramics from both the eastern and western sides of the Andes, suggesting interactions with foraging and farming groups in these areas (Durán et al. 2006; Neme 2002; Neme et al. 2013; Otaola et al. 2015). It is consequently thought that the groups occupying the high elevations of the southern Andean interior were mobile hunter-gatherers who nonetheless were articulated within the larger regional economy by supplying farmers in the lowlands with resources available only in the mountains (e.g., guanaco meat and obsidian), exchanged for items produced by agriculture-based societies, especially domesticates like *Phaseolus* and maize (Cornejo and Sanhueza 2003, 2011). Importantly, farming societies like those represented by the Llolleo, Bato, and Aconcagua complexes (characterized as wide-ranging, mostly horticultural groups living in small hamlets that are marked by distinctive ceramic traditions, pipe smoking, little or no status differentiation, and in some cases use of domesticated llamas), do not appear until between 1500 and 900 B.P. to the west, in Chile (Falabella et al. 2007; Falabella and Stehberg 1989; Lagiglia 1968). To the east, in Argentina, domestic crops like maize, beans, quinoa, and squash also appear in the record at this time, but it seems their overall contribution to subsistence, at least as measured by stable isotope studies and archaeobotanical data, was minimal (Gil et al. 2011; Llano et al. 2011).

Worldwide, though there is considerable variability in high altitude lifeways, contemporaneity between permanent or semipermanent high altitude residential use, and both foraging and farming intensification in adjacent lowland settings is not uncommon. On the Ethiopian Plateau (Phillipson 2000), the Tibetan Plateau (Brantingham 2006), the Caucasus (Adler et al. 2006), the Alps (Leveau and Walsh 2005) and the northern Andes (Aldenderfer 1998; Moore 1998; Reinhard 2002; Rick 1980), low intensity, highly-mobile, high-altitude hunting and foraging was established early in each region's prehistory. But settlements containing domiciles and extensive middens indicative of permanent or semipermanent occupation in mid-latitude settings were often (though not always) established after some sort of shift in basic economic pursuits, usually either to herding or agriculture, but also towards more intensive, broad-spectrum hunter-gatherer economies (Aldenderfer and Zhang 2004; Chen et al. 2015;

d'Alpoim Guedes et al. 2014; Phillipson 1977; Walsh et al. 2006; Williams 2006). In North America, somewhat similar patterns pertain, with the establishment of albeit seasonally-occupied high altitude villages in California's White Mountains (Bettinger 1991), central Nevada's Toiyabe Range (Thomas 1982, 1994), and Wyoming's Wind River Range (Morgan et al. 2012; Stirn 2014) mainly in the last 2000 years or less. More intensive use of high altitudes is also seen in California's Sierra Nevada mountains (Morgan 2006; Stevens 2005) and Utah's Uinta Range (Nash 2012; Watkins 2000) during this time, which is marked in general by regional population increases (Bettinger 1999) as well as the florescence of maize agriculture in the valleys south of the Uinta Range.

Explaining these shifts is a vexing problem. Some have linked population expansion and economic intensification to more intensive use of the highlands (Basgall 1987; Bettinger 1991; Stevens 2005) while others note that high altitude intensification in many cases is contemporaneous with climatic shifts which may have increased the biotic productivity and/or predictability of alpine and subalpine ecozones (Losey 2013; Morgan et al. 2014b). The problem with the latter perspective, especially in Wyoming, is that such climatic shifts and intensified, residential alpine land use are also contemporaneous with evidence for economic intensification in the lowlands, in particular shifts to eating more low-return resources like geophytes and increased investments in constructing residential facilities (Smith and McNeas 1999, 2011; Trout 2015). This explanatory conundrum makes new data from rare high altitude village sites like RDLI all the more intriguing because of the possibility of linking highland patterns with lowland ones and the opportunity to explore temporal correlations for climate change derived from paleoenvironmental proxy records and high altitude village occupational histories. Here we use data from test excavations at RDLI to do exactly that: to explore potential linkages between climate, lowland adaptive patterns, and high altitude village dynamics in the Mendoza region of Argentina as a means of developing hypotheses that might explain not only southern Andean mountain-adapted patterns, but global ones as well.

Environmental Setting

The study area is in the upper Diamante River watershed on the eastern slope of the southern Andes, in Mendoza Province, Argentina (FIGURE 1). The upper Diamante watershed is capped by peaks as high as 5000 masl. Much of the area above 3700 masl is currently glaciated or harbors permanent snowfields; glacial landforms characterize much of the landscape above 2800 masl (Volkheimer 1978). Upper ridgelines drop sharply into steeply-incised and often narrow canyons draining the high country. Large rivers like the Diamante and its major tributary, the Barroso, are difficult to ford even during relatively low water in the summer.

Precipitation, temperature, flora, and fauna are strongly conditioned by elevation (Capitanelli 1972; Solbrig et al. 1984). At 1400 masl, annual precipitation is only 300 mm but near 3000 masl, precipitation falls mainly as snow, averaging 800 mm per annum. At 2000 masl elevation, mean annual temperature is 9° C; at 3000 masl this number drops to 0° C, bracketed by maxima and minima of 25° C and -30° C, respectively. Elevations between the foothills (CA.

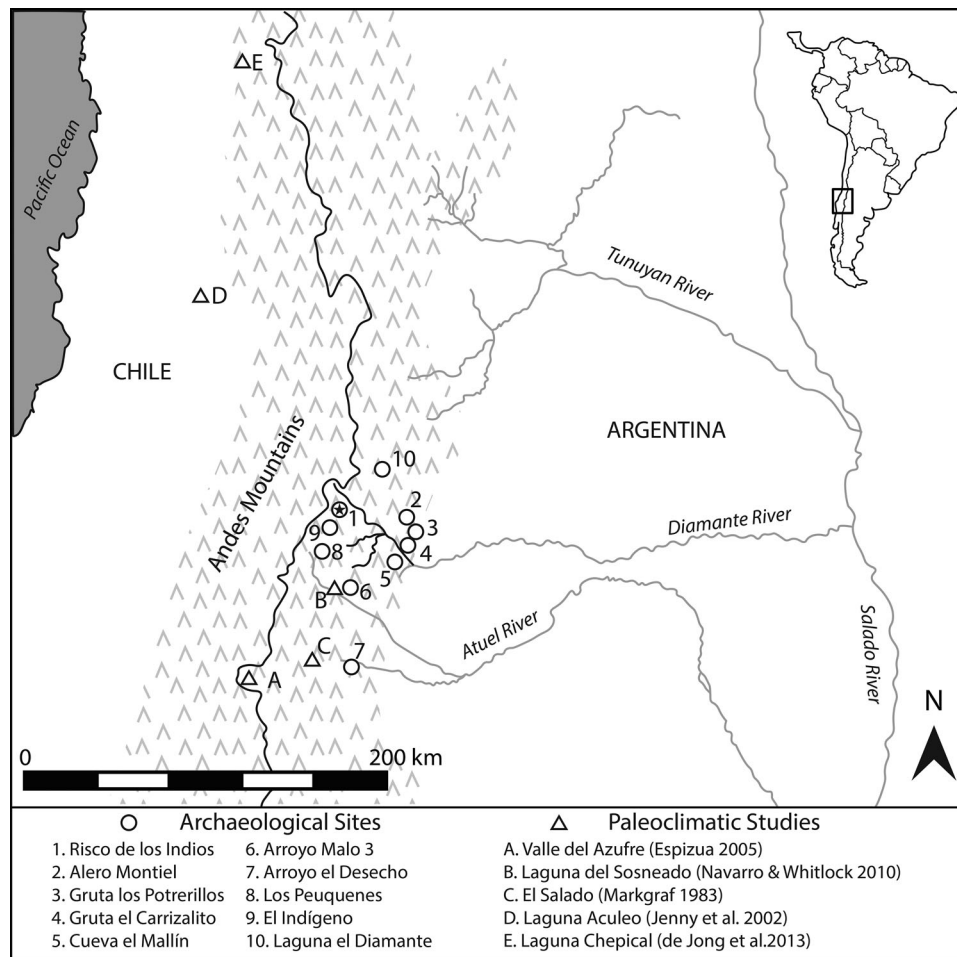


Figure 1. Map showing the location of Risco de los Indios and other important archaeological sites and paleoclimatic proxy studies in the greater southern Mendoza region.

1500 masl) and 3000 masl (above which is an alpine floristic province marked by sparse cushion plants, bare rock, and ice) fall within the Altoandean phytogeographic province, which is dominated by low shrub (*Asteraceae*) and grass (*Poaceae*) steppes (Cabrera 1976). On brushy hillsides leña amarilla (*Adesmia pinifolia*—which grows to 3400 masl and is often used for firewood), pataguilla–colimamul (*Anarthrophyllum* sp.), and molle (*Shinus odonellii*) are common. Small seeded species and greens exploited by humans like calafate (*Berberis empetrifolia*), molle (*Shinus poligamus* and *johnstonii*), alelí de las sierras (*Rhodophiala tuberosum*), and porotera (*Senna arnottiana*) are also found on Altoandean hillslopes. Grasses encountered in mountain valleys are pasto hilo (*Poa holciformis*), tussock grass (*Deschampsia venustula*), and coiron duro (*Pappostipa chrysophilla*). Various cacti (e.g., yerba del guanaco [*Maihuenia patagonica*]) are found throughout the Altoandean province (Cabrera 1976; Muiño et al. 2012; Roig 1960). Faunal diversity is low and characterized by only two large mammals: guanaco (*Lama guanicoe*) and mountain lion (*Puma concolor*). Small rodents (e.g., *Akodon* sp. and *Phyllotis* sp.), reptiles, and armadillo (*Dasyproctidae*) round out the indigenous faunal community. Migratory waterfowl frequent high elevation lakes and waterways on a seasonal basis (Roig 1972).

Risco de Los Indios

RDLI measures 25 by 110 m and is distinctive for its 29 stacked rock features (FIGURE 2). All but five of the features

are circular or ovoid in plan and between 3 and 4 m in diameter; the remainder are linear arrangements and “U” or “C” shaped structures. The structures, which vary from two to seven courses high, resemble the rock-ringed housepits found at similar altitudes in North America; it is unclear if or what kind of superstructures topped the features (Bettinger 1991; Thomas 1982). Some of the features are contiguous, forming “blocks” of circular structures, in particular Structures 12, 13, 14A and 14B (FIGURE 3). The site also contains a surface scatter of mainly fine-grained volcanic (FGV), cryocrystalline silicate (CCS), and obsidian flaked stone knapping debris, burned and unburned animal bone, a small quantity of ceramic sherds, and an approximately meter-thick deposit of anthropogenic midden soils containing lithics, ceramics, animal bone, and macrofloral remains. The site is situated at 2480 masl in a low, gentle swale atop a ridge and below a distinctive, 40 m-high dacite cliff face ringed by a steep talus slope, the latter forming the northern site boundary. The top of the cliff is capped by a cairn of dacite slabs CA. 3 m in diameter and believed to also be of aboriginal origin. A perennial stream is 80 m west of the site and down a steep embankment. This stream flows into the Barroso River some 1.1 km south of the site.

Excavations

A single 1×1 m unit was excavated in the center of Structure 22, one of the more intact circular features at the site, situated in an area with a particularly well-developed midden. The

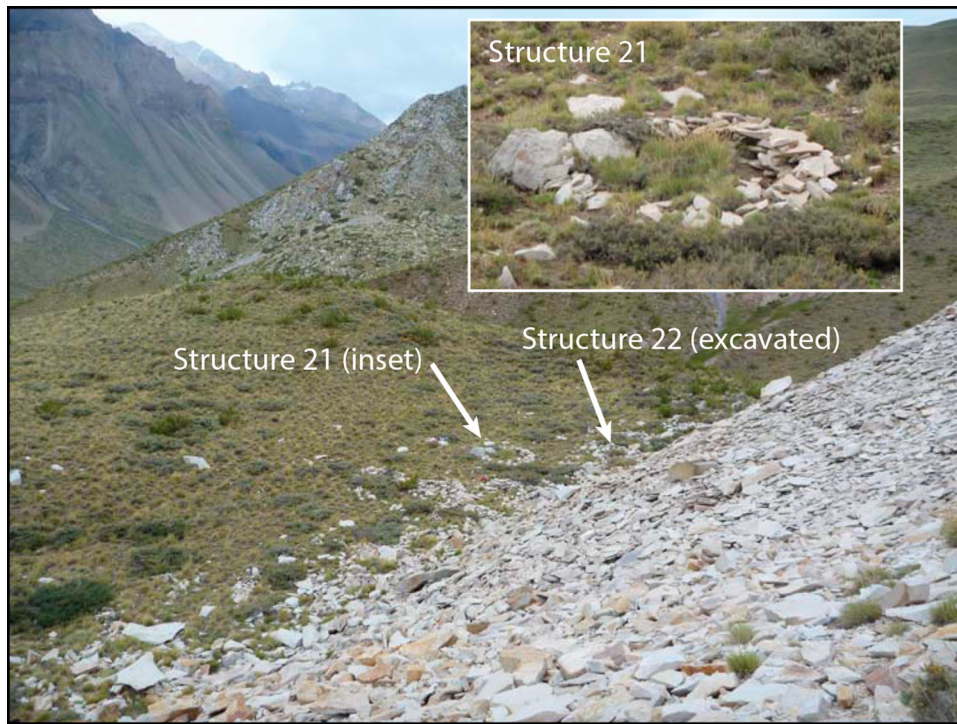


Figure 2. Photograph of Risco de los Indios, looking southwest, showing location of excavated Structure 22 and (inset) details of Structure 21 showing the multi-course, stacked rock construction method.

unit was excavated in 5 cm arbitrary levels save for the last level, which was excavated in a single 15 cm level. In total, 16 levels were excavated, to a maximum depth of 90 cm below the surface (weather and time constraints prevented us from reaching truly sterile basal levels). All sediments were passed through a 2 mm mesh, with all cultural material bagged separately by level. Sediment samples (in 16 liter [5 gal.] buckets) were taken from each level for flotation, recovery, and identification of macrofloral remains. Recovered cultural materials consist of 2807 items, the majority of which (75%) are faunal bone; the remainder consists of ceramics (14%), lithics (10%), and pigments like hematite (1%). Most of the cultural material is between Levels 3 and 14, 10–70 cm below the surface.

Stratigraphy

The profile of the north wall of Unit 1 in Feature 22 indicates three main strata: an upper 10–12 cm of recently-developed surface soils; 50 cm of well-developed midden soils; and 30 cm or more (the sterile base of the deposit was not reached) of slightly less-well developed midden that, while containing abundant cultural materials, contains less charcoal and organic materials than the overlying midden (FIGURE 4). The top 12 cm (Stratum I) consists of an 8–10 cm thick, organic “A” horizon overlying a 2–4 cm thick, leached “E” horizon. These recent and developing soils overlie the main site deposit (Stratum II), a sandy midden containing abundant cultural materials as well as lenses of charcoal and ash.

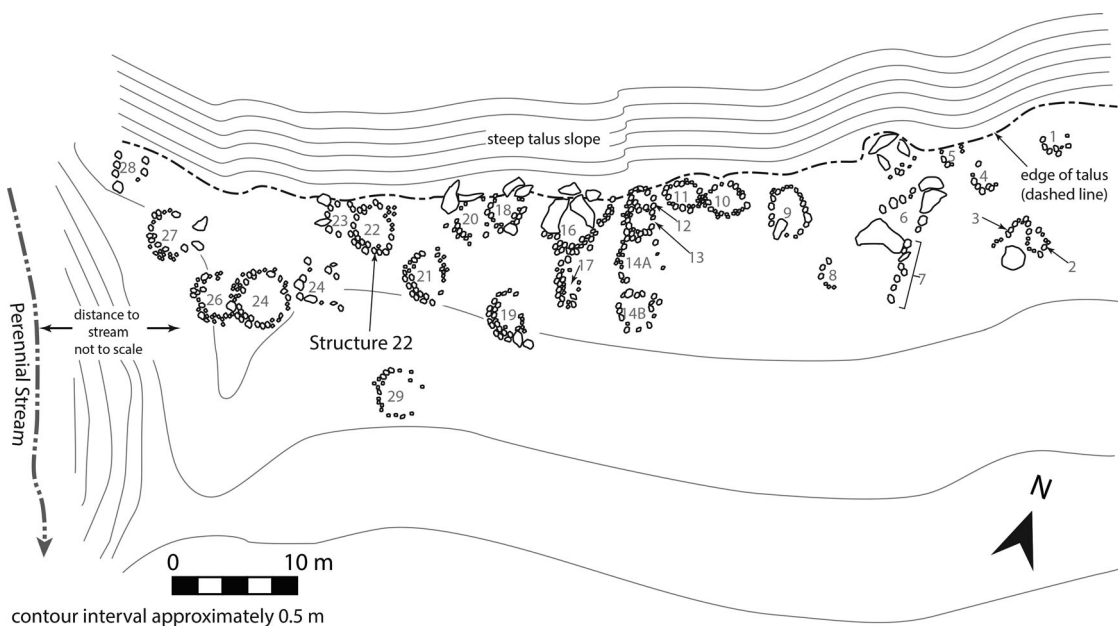


Figure 3. Risco de los Indios site map.

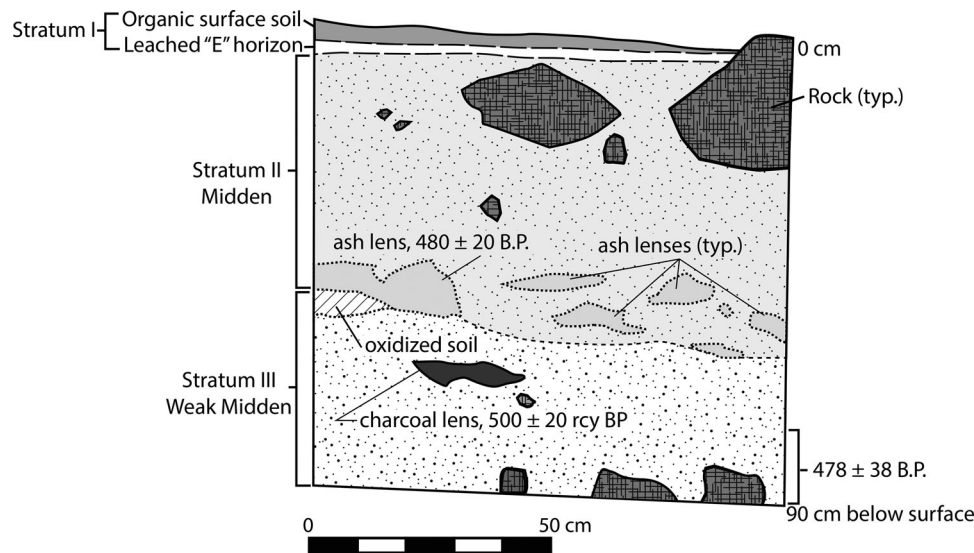


Figure 4. Unit 1 profile, north wall.

Both of the above strata contain large, angular dacite slabs indicative of colluvial deposition from the nearby talus slope, or perhaps rockfall from Structure 22's sidewalls. The basal stratum (Stratum III) is a fine sandy subsoil and a more weakly-developed midden than Stratum II; Stratum III also contains angular colluvial dacite clasts, ash, and an oxidized area of soil underlying an ash lens.

Analytical Results

Radiocarbon

Carbon samples were recovered from both an ash and a charcoal lens on the north wall of Unit 1 as well as from the matrix of the deepest level, 75–90 cm below the surface (FIGURE 4). The samples from the sidewall were run by the University of Georgia Center for Isotopic Studies (UGAMS 13578 and 13579) and the sample from the deepest level was run by the Arizona Accelerator Mass Spectrometry Laboratory at the University of Arizona (AA 102653) (TABLE 1). Radiocarbon dates range from 478 to 500 B.P. Though mean radiocarbon dates technically result in a minor stratigraphic reversal, the errors associated with these dates overlap substantially, meaning that the strata these dates are associated with must at this point be considered as representing a suite of undifferentiated occupations between approximately 477 and 553 CAL B.P. (at two sigmas).

Ceramics

A total of 284 ceramic sherds was analyzed, the majority of which were recovered between Levels 2 through 6 (5–30 cm below the surface). The sherds were cleaned, cut to produce fresh surfaces by which to identify paste and temper, and subjected to macroscopic and microscopic analyses (with a Nikon SMZ 800 stereoscopic microscope). Recorded

variables include thickness, temper, surface treatment, vessel shape, surface residues, and pottery type.

Sherd thickness ranges from 3.58 to 13.77 mm, with a mean of 6.91 mm, but most sherds are between 5.5 and 7.5 mm thick. Temper comprises between 10% and 20% of sherd matrices and ranges from fine to medium to large-sized clasts, mostly sand. Plainwares comprise 91.2% of the sample, with the majority (91.1%) showing smoothed surfaces. Some sherds (28.6%) also show evidence of polishing and only 1.5% show evidence of brushing. Only 25 sherds (8.8%) are painted with either red, white, black on white, red on white, and red and black pigments (FIGURE 5); all painted sherds represent nonlocal types (e.g., Aconcagua). Vessel forms, where discernable, consist of restricted necked pots with rounded bases. Combined with the soot and organic residues on interiors (32.4% of the sample) and exterior walls (53% of the sample), these forms suggest use as cooking and perhaps as storage vessels. Identified pottery types consist of Overo, Nihuil, Aconcagua, Atuel, and Rojo (TABLE 2). These types have been found in other, similar high altitude settings nearby (Lagiglia 1997). Aconcagua and other nonlocal, mostly decorated sherds show either interaction with or transport from other regions like northern Chile (Falabella et al. 2001; Lagiglia 1977).

Lithics

The lithic assemblage is composed of 283 artifacts, 261 of which are debitage, 21 of which are formed tools and one is a silicified sandstone core. Basalt is the most common material type, followed by cryptocrystalline silicates (CCS), obsidian, silicified sandstone, rhyolite, and trace amounts of dacite, andesite, slate, and granite (FIGURE 6). The remaining tools consist of a rhyolite hammerstone fragment, a basalt mano fragment, a spindle whorl made of sedimentary

Table 1. Radiocarbon dates from Risco de Los Indios.

Lab Code	Material	Provenience	Depth*	B.P.	CAL B.P. [†]
AA 102653	Charcoal	Dispersed charcoal recovered from Level 10	75–90	478 ± 38	477–553
UGAMS 13579	Charcoal	Ash lens near base of Stratum 2, N. wall Unit 1	55	480 ± 20	510–540
UGAMS 13578	Charcoal	Charcoal lens near top of Stratum 3, N. wall Unit 1	72	500 ± 20	505–534

*cm below surface; †calibrated at 2 sigmas with Calib 7.0 (Stuiver and Reimer 1993) and the Intcal 13 calibration curve (Reimer et al. 2013).



Figure 5. Sherds recovered from Risco de los Indios.

Table 2. Frequency and percentages of pottery types identified at RDLI.

Type	Overo	Nihuil	Aconcagua	Atuel (brushed)	Rojo (polished)	Nonlocal	Indet.	Total
Count	86	91	3	4	9	17	74	284
Percentage	30%	32%	1%	1%	3%	6%	26%	100%

material, a small, drilled steatite bead, five CCS and silicified sandstone unifaces (one of which is a large chopper), and 13 obsidian and CCS bifaces. Eight of the bifaces are small, triangular, concave-based arrow points, seven made of obsidian, one of CCS (FIGURE 7).

As exhibited by the data presented in Table 3, following the typology developed by Aschero (1983), most of the debitage

consists of angular shatter, flake fragments, and core reduction debris made on basalt, CCS, and obsidian; there is very little evidence for manufacture, maintenance, or repair of formal flaked stone tools. Evidence of differential curation of different material types, however, is exhibited by a comparison of the frequency of dorsal flake scars per mm² on flakes, a proxy for the intensity of raw material reduction and, by inference, curation (Ingbar 1994; Ingbar et al. 1989). As Figure 8 illustrates, obsidian debitage has on average three times more dorsal flake scars than basalt or silicified sandstone debitage and nearly double that of CCS flakes, suggesting more intensive curation of obsidian. This is not surprising given that basalt, silicified sandstone, CCS, and other lithic raw materials are found nearby, as clasts in Barroso River sediments and as outcrops throughout the region. The exception to this is obsidian. XRF trace element analysis of five obsidian artifacts from RDLI indicates provenance from the Las Cargas (n = 4) and Coche Quemado (n = 1) quarries, 100 km and 200 km away respectively from RDLI. Though the XRF sample size is small, it is interesting that no obsidian was sourced to the Laguna del Diamante quarry, which is only 30 km from the site.

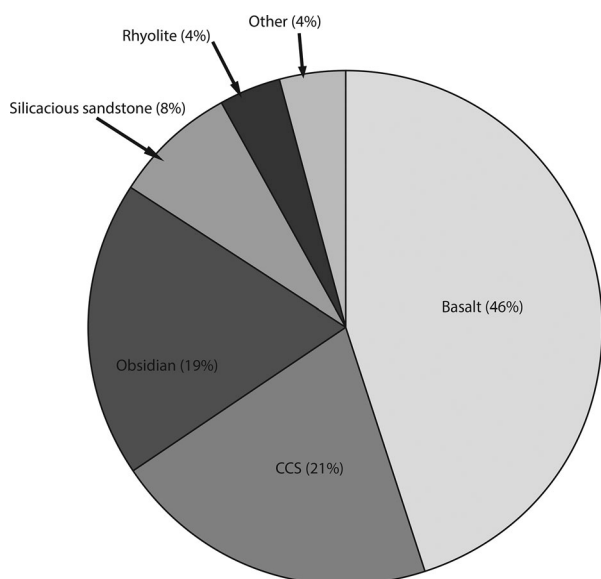


Figure 6. Flaked stone raw material percentages. CCS = cryptocrystalline silicates.

Macrobotanical Remains

A total of 39 seeds, seed husks (endocarps), leaves, and seed leaves (cotyledons) were recovered by flotation (TABLE 4). Taxon identification was conducted via macro and microscopic visual comparison to reference collections and published reference materials (Babot et al. 2007; Martin and



Figure 7. Projectile points recovered from Risco de los Indios.

Table 3. Debitage analysis results.

Flake type	Basalt	Obsidian	CCS	Sil. Sandstone	Other	Total
Nodular Flake	8 (6%)	3 (7%)	3 (6%)	3 (17%)	2 (10%)	19 (7.3%)
Primary	10 (8%)	1 (2%)	2 (4%)	2 (11%)	2 (10%)	17 (6.5%)
Secondary	12 (9%)	–	1 (2%)	1 (6%)	3 (15%)	17 (6.5%)
Flake Edge (frag.)	43 (33%)	8 (20%)	14 (26%)	4 (22%)	5 (25%)	74 (28.4%)
Angular Shatter	47 (36%)	7 (17%)	26 (49%)	6 (33%)	8 (40%)	94 (36.0%)
Flat Flake	5 (4%)	–	2 (4%)	1 (6%)	–	8 (3.1%)
Biface Thinning	–	–	2 (4%)	–	–	2 (0.8%)
Flake Reactivation	3 (2%)	22 (54%)	3 (6%)	–	–	28 (10.7%)
Non-diagnostic	1 (1%)	–	–	1 (6%)	–	2 (0.8%)
Total	129	41	53	18	20	261

Barkley 1973; Muiño et al. 2012; Singh et al. 1991). Wild taxa identified in Levels 1 and 2 included charred endocarps of *Schinus johnstonii*, a low-lying woody shrub that produces small, fleshy fruits (Barkley 1944); *Maihuea patagonica*, a small cactus (Hunt et al. 2006); *Maihuea glomerata*, a common, widely distributed cactus (Hoffmann and Walter 1989); and the leaf of a wild legume found in mountain steppes (Contu 2012). Charred remains of *Phaseolus vulgaris* were found in Levels 10–13 and 16. All these plants, wild or domestic, were eaten or otherwise used by the region’s aboriginal inhabitants. Though the literature is somewhat unclear on the subject (few vegetation studies have been conducted in the southern Andes), all these taxa save *Phaseolus* (which grows best between 500 and 1500 masl) grow in the Altoandean biotic province containing RDLI, suggesting they were locally available to the site’s inhabitants (Wortmann 2006).

Faunal Material

A total of 1430 pieces of animal bone was recovered, of which 347 were taxonomically identified. Taxa determinations were made following Lyman (1994) using comparative collections housed at the San Rafael Natural History Museum, Argentina and published reference material (Giardina 2010; Pacheco Torres et al. 1986). Herbivorous, large, and indeterminate mammal remains dominate the assemblage, comprising 97% of the identified specimens. We argue it is safe to say that a majority of these specimens (i.e., 63–97%) represent guanaco bone (especially the large mammal, Camelidae and *L. guanaco* taxon identifications), given the fact that the only other large mammal in the Altoandean province is puma (FIGURE 9). Crania are the most common elements identified in the assemblage, though other elements (mandible, vertebrae, ribs, portions of the pelvis, femur, humerus, and smaller bones of the distal appendicular skeleton) were also identified, suggesting animals were brought back to the site whole, or nearly whole, and processed on-site. Smaller mammals including canids (*Pseudalopex culpaeus*) and armadillo (Dasipodidae) are present in trace amounts. Cut marks, bone chipping, and perimeter marking indicative of anthropogenic processing were identified on only 7% of the sample, though 62% of the sample is either burnt, charred, or calcined, indicating cooking over open fires and/or burning after discard.

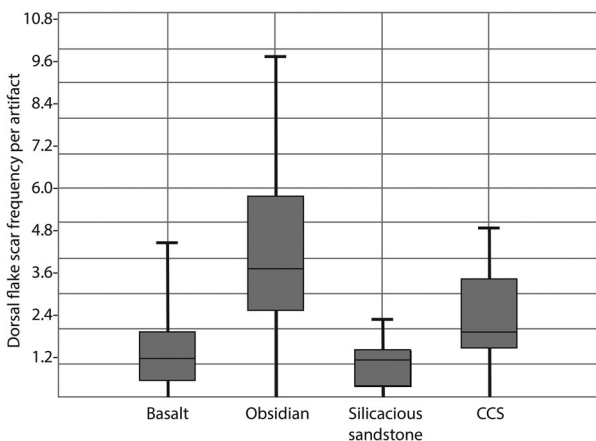


Figure 8. Dorsal scar frequency per artifact, by raw material type. CCS = crypto-crystalline silicates.

Discussion

The abundance of rock ring features at the site is consistent with descriptions of high altitude domiciles both in the Andes (Aldenderfer 1998; Lagiglia 1997; Neme 2016) and beyond (Bettinger 1991; Morgan et al. 2012; Thomas 1982),

Table 4. Macrobotanical remains recovered from Unit 1, by level.

Level	Family	Genus and Species	Element	Condition	Type	Count
1	Anacardiaceae	<i>Schinus johnstonii</i>	Endocarp	Charred	Wild	2
	Cactaceae	<i>Maihuenia patagonica</i>	Seed	Uncharred	Wild	3
	Cactaceae	<i>Maihueniopsis glomerata</i>	Seed	Uncharred	Wild	1
	Fabaceae	<i>Anarthrophyllum rigidum</i>	Leaf	Uncharred	Wild	7
2	Anacardiaceae	<i>Schinus johnstonii</i>	Endocarp	Uncharred	Wild	3
3–9			No macrobotanical remains recovered			
10	Fabaceae	<i>Phaseolus vulgaris</i>	Cotyledon	Charred	Domestic	4
11	Fabaceae	<i>Phaseolus vulgaris</i>	Cotyledon	Charred	Domestic	1
12	Fabaceae	<i>Phaseolus vulgaris</i>	Cotyledon	Charred	Domestic	11
13	Fabaceae	<i>Phaseolus vulgaris</i>	Cotyledon	Charred	Domestic	1
14	Indet.	n/a	n/a	Charred	n/a	1
15			No macrobotanical remains recovered			
16	Fabaceae	<i>Phaseolus vulgaris</i>	Cotyledon	Charred	Domestic	5

strongly suggesting that the structures at RDLI are indeed residential features. The presence of cooking refuse (charcoal, burned animal bone, and macrofloral remains) and domestic items (especially sherds and groundstone artifacts) supports this assertion, as does the diversity of the site's artifact assemblage according to the Clarke Effect (Schiffer 1987: 54–55). Assuming some degree of contemporaneity (which, however, has yet to be shown), the number of residential structures at the site suggests multi-family aggregations, though it is conceivable at this early stage in the site's research history that they might represent a palimpsest of repeated occupations. Radiocarbon dates and diagnostic artifacts indicate late Holocene occupation CA. 500 CAL B.P. The concordance of radiocarbon dates between 45 and 72 cm below the surface indicates rapid accumulation of thick midden deposits, suggesting intensive use of the site over a relatively brief period of time, perhaps as few as 76 years (the span of the radiocarbon dates at 2 sigmas), though clearly more dates are needed to substantiate this claim.

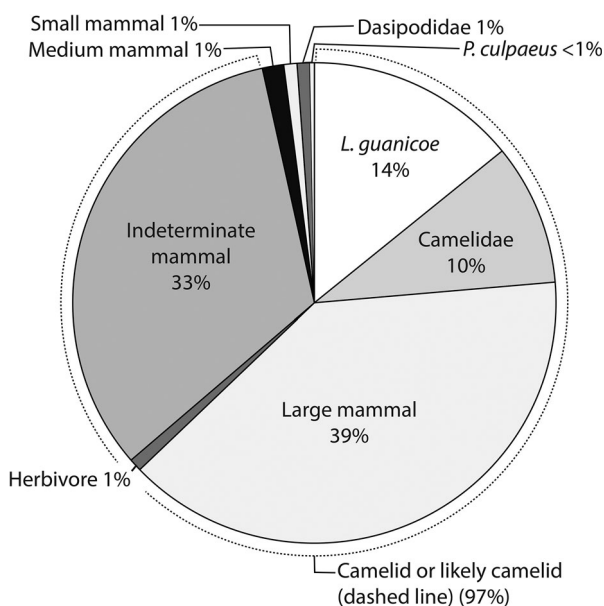
The fact that the midden is dominated by large animal bone, most of it guanaco or likely guanaco, suggests the site was a residential base (*sensu* Binford 1980) geared mainly towards accessing this type of prey. The fact that both low and high utility elements comprise the faunal assemblage suggests either that RDLI inhabitants faced considerable resource stress and were processing even low utility items (unlikely given the density, thickness, and diversity of the

site's midden and the lack of evidence for intensive bone processing or greasing) or, much more likely, that animals were captured near enough to the site to reduce transport costs to the point that it was more efficient to bring entire carcasses back to the site where they were processed, cooked, and consumed (Binford 1977; Burger et al. 2005; Metcalfe and Jones 1988). Though it is possible that both situations may have been at play, the fact that we regularly saw guanaco on the ridge adjacent to the site during our work there lends some credence to the latter assertion.

Though the majority of the faunal, macrofloral, and lithic material may be procured at or near the site, nonlocal obsidian, exotic Chilean ceramics and domestic beans, which likely were grown in the lowlands, and perhaps as far away as central Chile (Durán 2000; Falabella et al. 2007; Hernández 2002; Llano et al. 2011) indicate considerable mobility across and within the south-central Andes. They also likely indicate contact with Chilean groups to the north and west and with Argentine groups living along the eastern Andean front. Importantly, the presence of nonlocal, domestic beans suggests guanaco hunting at the site was subsidized (to an extent as-yet unclear) in part by transporting plant foods from lower elevations, a pattern also seen in several of North America's high ranges, in particular in California's Sierra Nevada mountains and White Mountains and Utah's Uinta Mountains (Nash 2012; Rhode in press; Scharf 2009; Watkins 2000).

The patterns identified at RDLI are mostly consistent with those seen at other southern Andean high altitude residential sites. In terms of subsistence, it appears camelid hunting drove the occupation of both RDLI and the three other known residential sites in the Atuel and Diamante watersheds; camelids comprise between 88% and 98% of their faunal assemblages (Durán et al. 2006; Giardina et al. 2014; Neme 2016). In a similar vein, though local plants (e.g., *Shinus* sp., *Anartrophilum* sp., and various cacti) were also exploited at these other sites, it also appears *Phaseolus* was brought to each (Gil et al. 2014; Lagiglia 2001; Planella and Planella 2004). Extralocal ceramics and obsidian artifacts were also identified at these other sites, suggesting considerable mobility within and across the Andes, in an area encompassing modern day Chile, the Andean crest, and the foothills of the Andes in western Argentina (Falabella et al. 2001; Lagiglia 1997; Lagiglia et al. 1994; Sanhueza et al. 2004).

The main differences between RDLI and the three other known high altitude villages in the southeastern Andes are their respective radiocarbon dates, numbers of structures, and elevations. RDLI is the second youngest of the bunch and also the lowest in elevation. When radiocarbon summed

**Figure 9.** Percentages of faunal taxa identified at Risco de los Indios.

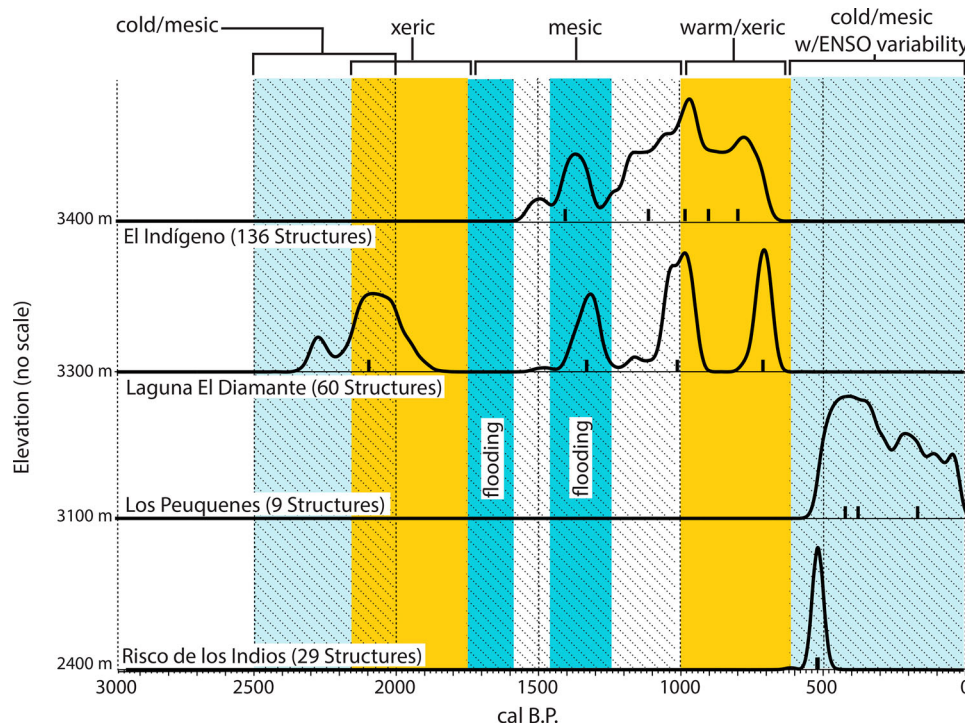


Figure 10. Summed probability distributions of radiocarbon dates from the four known high altitude village localities in the southern Mendoza region of the southern Andes superimposed on a regional paleoclimatic synthesis based on the literature reviewed herein (see FIGURE 1 for study locations). Distributions generated at 2 sigmas with CalPal 2015 (Weninger et al. 2015) and the Intcal 13 radiocarbon calibration curve (Reimer et al. 2013). ENSO = El Niño Southern Oscillation.

probability distributions (c.f. Steele 2010; Williams 2012), elevations, and number of structures at each village site in the region are graphed, it appears higher, larger sites (El Indígena and the Laguna el Diamante sites) were occupied earlier and lower, generally smaller sites (Los Peuquenes and RDLI) were occupied later (FIGURE 10). This suggests that intensive high elevation village use in the region began approximately 2100 years ago, was most intensive between about 1500 and 600 years ago, and that high elevation residential use may have declined or at least shifted to somewhat lower elevations in the very Late Holocene.

Given the marginality of high altitude settings (Beall 2001; Lozny 2013; Simonson 2015) and their sensitivity to climatic fluctuations (Innes 1991; Morgan et al. 2014b; Smith et al. 2009), a candidate for explaining both the intensification (*sensu lato*, Morgan 2015) of high altitude residential use and variation in such use through time is climate. But as proxy records from both the eastern and western slopes of the southern Andes (of which there are admittedly relatively few) show, making such causal connections is problematic. On the eastern side of the southern Andes, these records indicate mainly wet and cold conditions between 2500 and 2000 CAL B.P., during the establishment of the first high altitude village in the region (Durán et al. 2006; Navarro and Whitlock 2010) (FIGURE 10). On the western slope of the southern Andes, drier conditions pertained between 2150 and 1750 CAL B.P., a period overlapping with the first occupations at Laguna el Diamante (Jenny et al. 2002). This results in a situation where it is unclear as to whether or not the earliest high altitude village occupation was during a wet or a dry period, though it is possible this conflict results from the paucity of proxy records and differences in paleoenvironments and atmospheric circulation on either side of the Andes.

More clear is that mesic conditions returned between 1750 and 1000 CAL B.P., with markedly wetter conditions and

flooding characterizing regional climate CA. 1400 CAL B.P., when both Laguna el Diamante and the region's largest high altitude village, El Indígena, were occupied (Jenny et al. 2002; Neme 2016). Though the nature and expression of the Medieval Warm Period (MWP) in South America is contentious, it appears generally warmer, drier conditions pertained in Argentina between approximately 1000 and 600 CAL B.P. (Cioccale 1999; Haberzettl et al. 2005; Mauquoy et al. 2004), the period of time representing the latter half of the occupations at both Laguna el Diamante and El Indígena. This results in a situation where occupations of the region's largest high altitude villages transgress a fundamental change in climate from mesic to xeric conditions, suggesting that climate had little effect on the occupational history of these sites.

By 600 CAL B.P., increasingly cold conditions pertained, these associated with the Little Ice Age (LIA) (Espizua 2005; Stingle and Garleff 1985). LIA conditions intensified after 400 CAL B.P., a period also characterized by an increase in the frequency and amplitude of the El Niño Southern Oscillation (ENSO) (de Jong et al. 2013; Jenny et al. 2002; Lamy et al. 2002). This is when Laguna el Diamante and El Indígena appear to have been abandoned and when lower elevation sites like Los Peuquenes and RDLI were occupied. In sum, proxy records provide conflicting information regarding the first occupations of the region's earliest high altitude village locality, Laguna el Diamante. That site and El Indígena, the region's largest and highest village, were both occupied over a span of time marked both by pronounced mesic conditions but also the dry-warm MWP, a confounding situation that calls into question the idea of a causal connection between climate and high altitude intensification. Slightly more plausible is that colder and more variable LIA environmental conditions drove the region's inhabitants to lower settings like Los Peuquenes and especially RDLI (Cioccale 1999; Losey 2013; Morgan 2009).

More telling than the problematic and rough temporal correlations between some climatic and cultural changes are trends in the region's archaeology that point to resource stress, intensified foraging and agricultural production, and increasing population density, all of which may have caused more intensive use of high altitudes. Beginning approximately 2000 CAL B.P. and continuing until approximately 1000 CAL B.P., regional artiodactyl indexes (*sensu* Broughton 1994) decrease; this is related to an increase in the frequencies of smaller animals in the region's archaeofaunal assemblages (Neme 2007; Otaola 2014). There is also an increase in evidence for reliance on small-seeded, costly-to-process wild and domesticated plants including beans, maize, chenopods, and squash (Falabella et al. 2007; Gil et al. 2011; Gil et al. 2014; Hernández 2002). Both lines of evidence indicate widening diet breadth and likely declining hunting, foraging, and farming efficiency (Llano 2010, 2014; Llano et al. 2011), both often seen as markers of population pressure (Morgan 2015). The most direct measure of increasing population density and arguably population pressure (see Keeley 1988), however, is an increase in the number of sites and more radiocarbon dates during this same period of time (Neme and Gil 2009; Neme and Gil 2012). Taken together, these data suggest that increasing population density in lowland valleys may have resulted in an imbalance between population and resources, forcing more intensive occupation and exploitation of high altitude settings and resources (Neme 2007; Neme and Gil 2008).

Given this, we think demographic and economic factors likely hold the most predictive power for explaining the inception of intensive high altitude residential occupations. The weakness of the climatic correlation to high altitude intensification in the southern Andes and the inability of climate to account for high altitude intensification on the global stage and in terms of general theory lead to the conclusion that the connections between demographic expansion, economic intensification, and intensified alpine land use is clearer (Aldenderfer 2006; Bettinger 1991). In light of this, we argue that high altitude intensification in the southern Andes (and likely elsewhere) resulted from demographic pressures forcing more intensive use of both low and high elevation resources and locales.

Expectations derived from these hypotheses consequently consist of the following: contemporaneity of lowland and highland economic intensification (*sensu stricto*, Morgan 2015); evidence for increasing population density (e.g., diachronic and time corrected site frequencies and radiocarbon summed probability distributions) in lower elevations immediately before and during periods of high altitude village occupations; evidence for exchange, contact, or transhumance between lower and higher elevations (e.g., obsidian, ceramics, shell beads); and higher or at least equal returns from foraging and hunting in the highlands relative to the lowlands when high altitude residential sites are occupied. This last point is critical in that if economic concerns drove high altitude intensification in the region, then high altitudes would have to be at least equal in terms of economic potential as the lowlands; such an analysis would of course have to take into account population density and its effects on resource encounter rates in addition to gross comparison of resource return rates in both elevational settings. At this point, however, the connections between population dynamics, high altitude intensification, and less convincingly so, climate,

remain hypothetical. What is clear is that considerably more work is required to elucidate the connections between these phenomena through the development of explicit hypotheses and expectations, modeling, and substantially more fieldwork in the region, both in terms of generating more paleoenvironmental proxy data and in reconstructing both highland and lowland population densities, economies, and other behavioral patterns.

Conclusions

Our test excavations at RDLI resulted in a rich dataset showing that occupation of this high-altitude village site occurred for a brief but intensive time CA. 500 CAL B.P. Floral, faunal, and lithic assemblages indicate mainly a hunting economy (mainly of guanaco), supplemented by small quantities of smaller fauna like armadillo, locally available small-seeded plants, and small quantities of domestic beans transported from lowland settings, likely in Chile. Lithic and ceramic assemblages suggest RDLI's inhabitants were quite mobile, with a seasonal round encompassing most of the interior portion of the Andes and forays into both the western and eastern slopes of the range, in modern day Chile and Argentina. When compared to the three other known high elevation residential sites in the region, these behavioral patterns appear to be more-or-less the norm for the southern high Andes after about 2000 CAL B.P., save for the fact that such patterns appear to move to slightly lower elevations around 500 or 600 years ago, at the onset of the LIA and increasingly uncertain environmental conditions affiliated with the ENSO. Rather than being climatically mediated, however, it appears the initial push to develop these intensive high altitude behavioral patterns may be found in the valleys surrounding the Andes, where increasing population densities and intensified economies may have driven people to more intensively exploit the high Andes. As we hope we have shown, these hypothetical connections are based on some intriguing temporal correlations between the onset, florescence, and demise of high altitude village life in the southern Andes and on fundamental changes in demography and economy in the region. It thus indeed seems plausible that population pressure drove people to more intensively exploit and occupy the region's high altitude settings and that colder and more variable environmental conditions may have forced some sort of retreat from these settings. Evaluating these hypotheses will hopefully entail new and more comprehensive research in the region.

Acknowledgments

Special thanks are extended to our local guide Don Pedro Ponce and his family who showed us such warmth and hospitality during fieldwork. Thanks are also extended to A. Victor Durán and the National Gendarmerie for initial data and photographs of the site. Funding provided by the Argentine National Agency for Scientific and Technological Promotion (CONICET) Grant No. PICT-2013-0881 and the Office of the Vice Provost for Research and Innovation, University of Nevada, Reno.

Notes on contributors

Christopher Morgan (Ph.D. 2006, University of California, Davis) focuses on the prehistoric human ecology of hunter-gathers operating in marginal environments, particularly high mountains and deserts.

Gustavo Neme (Ph.D. 2002, Universidad Nacional de La Plata) focuses on faunal and floral resource exploitation patterns of the prehistoric inhabitants of the southern Andes and surrounding region, particularly those who lived at high altitudes.

Nuria Sugañes (Ph.D. candidate, Universidad del Centro de la Provincia de Buenos Aires) focuses on prehistoric ceramic technology and mobility patterns in the southern Andes.

Laura Salgan (Ph.D. 2010, Universidad Nacional de La Plata) focuses on lithic technological organization and obsidian conveyance patterns in the greater southern Andean region.

Adolfo Gil (Ph.D. 2000, Universidad Nacional de La Plata) focuses on long-term diachronic trends in the human paleoecology of Mendoza Province, Argentina and latterly the effect of maize domestication and adoption on settlement patterns and social organization.

Clara Otoala (Ph.D. 2013, University of Buenos Aires, Argentina) focuses on zooarchaeology and foraging adaptations in the Mendoza region of Argentina.

Miquel Giardina (Ph.D. 2010, Universidad Nacional de La Plata) focuses on faunal analysis and the prehistoric economies of the greater southern Andes.

Carina Llano (Ph.D. 2011, Universidad Nacional del Comahue) focuses on archaeobotany and prehistoric plant exploitation strategies in the southern Mendoza region.

References

- Adler, D. S., G. Bar-Oz, A. Belfer-Cohen, and O. Bar-Yosef. 2006. "Ahead of the Game: Middle and Upper Palaeolithic Hunting Behaviors in the Southern Caucasus." *Cultural Anthropology* 47: 89–118.
- Aldenderfer, M. 1998. *Montane Foragers: Asana and the South-Central Andean Archaic*. Iowa City: University of Iowa Press.
- Aldenderfer, M. 1999. "An Archaeological Perspective on the Human Use of Cold Montane Environments in Andean South America." *Revista de Arqueología Americana* 17-19: 75–96.
- Aldenderfer, M. 2006. "Modelling Plateau Peoples: The Early Human Use of the World's High Plateaux." *World Archaeology* 38: 357–370.
- Aldenderfer, M., and Y. Zhang. 2004. "The Prehistory of the Tibetan Plateau to the Seventh Century A.D.: Perspectives from China and the West since 1950." *Journal of World Prehistory* 19: 1–55.
- Aschero, C. 1983. *Ensayo Para Una Clasificación Morfológica De Artefactos Líticos Aplicados a Estudios Tipológicos Comparativos. Apéndices a-C. Revisión*. Buenos Aires: Cátedra de Ergología y Tecnología.
- Babot, M. d. P., N. Oliszewski, and A. Grau. 2007. "Análisis De Caracteres Macroscópicos y Microscópicos De *Phaseolus Vulgaris* (Fabaceae, Faboideae) Silvestres y Cultivados Del Noroeste Argentino, Una Aplicación En Arqueobotánica." *Darwiniana* 45: 149–162.
- Barkley, F. A. 1944. "Anacardiaceae *Schinus Johnstonii*." *Brittonia* 5: 160–198.
- Basgall, M. E. 1987. "Resource Intensification Among Hunter-Gatherers: Acorn Economies in Prehistoric California." *Research in Economic Anthropology* 9: 21–52.
- Beall, C. 2001. "Adaptation to Altitude: A Current Assessment." *Annual Review of Anthropology* 30: 423–456.
- Bender, S. J., and G. A. Wright. 1988. "High-Altitude Occupations, Culture Process, and High Plains Prehistory: Retrospect and Prospect." *American Anthropologist* 90: 619–639.
- Benedict, J. B. 2007. "Effects of Climate on Plant-Food Availability at High Altitude in the Colorado Front Range, USA." *Journal of Ethnobiology* 27: 143–173.
- Bettinger, R. L. 1991. "Aboriginal Occupation at High Altitude: Alpine Villages in the White Mountains of California." *American Anthropologist* 93: 656–679.
- Bettinger, R. L. 1996. "High Altitude Occupations in the American West." In *The Oxford Companion to Archaeology*, edited by B. M. Fagan, 275–276. New York: Oxford University Press.
- Bettinger, R. L. 1999. "What Happened in the Medithermal." In *Models for the Millennium, Great Basin Anthropology Today*, edited by C. Beck, 62–74. Salt Lake City: University of Utah Press.
- Binford, L. R. 1977. "Forty-Seven Trips: A Case Study in the Character of Archaeological Formation Process." In *Stone Tools as Cultural Markers: Change, Evolution, and Complexity*, edited by R. V. S. Wright, 24–36. Canberra: Australian Institute of Aboriginal Studies.
- Binford, L. R. 1980. "Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation." *American Antiquity* 45: 4–20.
- Bordley, R., and M. LiCalzi. 2000. "Decision Analysis Using Targets Instead of Utility Functions." *Decisions in Economics and Finance* 23: 53–74.
- Brantingham, P. J. 2006. "Peopling of the Northern Tibetan Plateau." *Archaeology at Altitude* 38: 387–414.
- Broughton, J. M. 1994. "Declines in Mammalian Foraging Efficiency During the Late Holocene, San Francisco Bay, California." *Journal of Anthropological Archaeology* 13: 371–401.
- Burger, O., M. J. Hamilton, and R. Walker. 2005. "The Prey as Patch Model: Optimal Handling of Resources with Diminishing Returns." *Journal of Archaeological Science* 32: 1147–1158.
- Cabrera, A. 1976. *Regiones Fitogeográficas Argentinas*. Buenos Aires: Acme.
- Capitanelli, R. 1972. "Geomorfología y Clima De La Provincia De Mendoza." *Revista De La Sociedad Argentina De Botánica (Supl.)* 13: 15–48.
- Chen, F. H., G. H. Dong, D. J. Zhang, X. Y. Liu, X. Jia, C. B. An, M. M. Ma, Y. W. Xie, L. Barton, X. Y. Ren, Z. J. Zhao, X. H. Wu, and M. K. Jones. 2015. "Agriculture Facilitated Permanent Human Occupation of the Tibetan Plateau after 3600 B.P." *Science* 347: 248–250.
- Cioccale, M. A. 1999. "Climatic Fluctuations in the Central Region of Argentina in the Last 1000 Years." *Quaternary International* 62: 35–47.
- Contu, S. 2012. "Anarthrophyllum Rigidum. The Iucn Red List of Threatened Species. Version 2015.2." Accessed July 28, 2015. www.iucnredlist.org.
- Cornejo, L., and L. Sanhueza. 2003. "Coexistencia De Cazadores Recolectores y Horticultores Tempranos En La Cordillera Andina De Chile Central." *Latin American Antiquity* 14: 389–407.
- Cornejo, L., and L. Sanhueza. 2011. "North and South: Hunter-Gatherer Communities in the Andes Mountains in Central Chile." *Latin American Antiquity* 22: 487–504.
- d'Alpoim Guedes, J., H. Lu, Y. Li, R. Spengler, X. Wu, and M. Aldenderfer. 2014. "Moving Agriculture onto the Tibetan Plateau: The Archaeobotanical Evidence." *Archaeological and Anthropological Sciences* 6: 255–269.
- de Jong, R., L. von Gunten, A. Maldonado, and M. Grosjean. 2013. "Late Holocene Summer Temperatures in the Central Andes Reconstructed from the Sediments of High-Elevation Laguna Chelcal, Chile (32° S)." *Climate of the Past* 9: 1921–1932.
- Dennell, R. 2004. "Hominid Dispersals and Asian Biogeography During the Lower and Early Middle Pleistocene, C. 2.0-0.5 Mya." *Asian Perspectives* 43: 205–226.
- Dieguez, S., and G. Neme. 2003. "Geochronology of the Archaeological Site Arroyo Malo 3 and the First Human Occupations in the North Patagonia Early Holocene." In *Ancient Evidence for Paleo South Americans: From Where the South Winds Blows*, edited by L. Miotti, M. Salemme, and N. Flegenheimer, 87–92. College Station: Center for the Study of the First Americans, Texas A&M University Press.
- Durán, V. 2000. *Poblaciones Indígenas De Malargüe, Serie libros N° 1. Facultad de Filosofía y Letras*. Mendoza: Universidad Nacional de Cuyo.
- Durán, V., G. Neme, V. Cortegoso, and A. Gil. 2006. "Arqueología Del Área Natural Protegida Laguna Diamante (Mendoza, Argentina)." In *Arqueología y Ambiente De Áreas Naturales Protegidas De La Provincia De Mendoza*, edited by V. Durán and V. Cortegoso, 91–143. Mendoza: Instituto de Arqueología y Etnología, Universidad Nacional de Cuyo.
- Espizua, L. 2005. "Holocene Glacier Chronology of Valenzuela Valley, Mendoza Andes, Argentina." *The Holocene* 15: 1079–1085.
- Falabella, F., T. Planella, E. Aspillaga, L. Sanhueza, and R. Tykot. 2007. "Dieta En Sociedades Alfareras De Chile Central: Aportes De Análisis De Isótopos Estables." *Chungara* 39: 5–27.
- Falabella, F., L. Sanhueza, G. Neme, and H. Lagiglia. 2001. "Análisis Comparativo De Cerámica Aconcagua Entre Chile y Argentina." *Relaciones* 26: 193–214.
- Falabella, F., and R. Stehberg. 1989. "El Periodo Agroalfarero Medio En Chile Central." In *Prehistoria De Chile, Desde Sus Orígenes Hasta Los*

- Albores De La Conquista*, edited by J. Hidalgo, V. Schiapacasse, H. Niemeyer, C. Aldunate, and I. Solimano, 295–311. Santiago: Editorial Andrés Bello.
- Gambier, M. 1979. *Investigaciones Arqueológicas En La Región Del Alto Río Diamante, Provincia De Mendoza. Publicaciones No 5*. San Juan: Instituto de Investigaciones Arqueológicas y Museo.
- Gambier, M. 1985. *La Cultura De Los Morrillos*. San Juan: Instituto de Investigaciones Arqueológicas y Museo, Universidad Nacional de San Juan.
- Giardina, M. A. 2010. “El Aprovechamiento De La Avifauna Entre Las Sociedades Cazadoras-Recolectoras Del Sur De Mendoza, Un Enfoque Arqueozoológico.” Ph.D. diss., Universidad Nacional de La Plata, Argentina.
- Giardina, M. A., G. A. Neme, and A. F. Gil. 2014. “Rheidae Egg Human Exploitation and Stable Isotopes: Trends from West Central Argentina.” *International Journal of Osteoarchaeology* 24: 166–186.
- Gil, A., G. Neme, and R. Tykot. 2011. “Stable Isotopes and Human Diet in Central Western Argentina,” *Journal of Archaeological Science* 38: 1395–1404.
- Gil, A. F., R. Villalba, A. Ugan, V. Cortegoso, G. Neme, C. T. Michieli, P. Novellino, and V. Durán. 2014. “Isotopic Evidence on Human Bone for Declining Maize Consumption During the Little Ice Age in Central Western Argentina.” *Journal of Archaeological Science* 49: 213–227.
- Haberzettl, T., M. Fey, A. Lücke, N. Maidana, C. Mayr, C. Ohlendorf, F. Schäbitz, G. Schleser, M. Wille and B. Zolitschka. 2005. “Climatically Induced Lake Level Changes During the Last Two Millennia as Reflected in Sediments of Laguna Potrok Aike, Southern Patagonia (Santa Cruz, Argentina).” *Journal of Paleolimnology* 33: 283–302.
- Hernández, A. 2002. “Paleoetnobotánica En El Sur De Mendoza.” In *Entre Montañas y Desiertos: Arqueología Del Sur De Mendoza*, edited by A. Gil and G. Neme, 103–118. Buenos Aires: Sociedad Argentina de Antropología, Serie Libros.
- Hevly, R. H. 1983. “High-Altitude Biotic Resources, Paleoenvironments, and Demographic Patterns: Southern Colorado Plateaus, A.D. 500–1400.” In *Cultural Resource Management: High Altitude Adaptations in the Southwest*, edited by J. C. Winter, 22–40. Albuquerque: United States Department of Agriculture, Forest Service, Southwestern Region.
- Hoffmann, A., and H. Walter 1989. *Cactáceas En La Flora Silvestre De Chile*. Santiago: Ediciones Fundación Claudio Gay.
- Hunt, D., N. Taylor, and G. Charles. 2006. *The New Cactus Lexicon*. Milborne Port, UK: DH Books.
- Ingbar, E. 1994. “Lithic Material Selection and Technological Organization.” In *The Organization of North American Prehistoric Chipped Stone Technologies*, *Archaeological Series 7*, edited by P. Carr, 45–56. Ann Arbor: International Monographs in Prehistory.
- Ingbar, E., M. Larson, and B. Bradley. 1989. “A Nontypological Approach to Debitage Analysis.” In *Experiments in Lithic Technology, BAR International Series 528*, edited by D. S. Amick and R. P. Mauldin, 67–99. Oxford: B.A.R.
- Innes, J. L. 1991. “High-Altitude and High-Latitude Tree Growth in Relation to Past, Present and Future Global Climate Change.” *The Holocene* 1: 168–173.
- Jenny, B., B. Valero-Garcés, R. Urrutia, K. Kelts, H. Veit, P. Appleby, and M. Geyh. 2002. “Moisture Changes and Fluctuations of the Westerlies in Mediterranean Central Chile During the Last 2000 Years: The Laguna Aculeo Record (331500s).” *Quaternary International* 87: 3–18.
- Keeley, L. H. 1988. “Hunter-Gatherer Economic Complexity and Population Pressure: A Cross-Cultural Approach.” *Journal of Anthropological Archaeology* 7: 373–411.
- Klein, R. G. 2008. “Out of Africa and the Evolution of Modern Human Behavior.” *Evolutionary Anthropology* 17: 267–281.
- Lagiglia, H. 1968. *Secuencias Culturales Del Centro-Oeste Argentino: Valles Del Atuel y Del Diamante. Científica de investigaciones del Museo de Historia Natural de San Rafael, Tomo I, No. 4*. San Rafael: Museo de Historia Natural de San Rafael.
- Lagiglia, H. 1977. “Dinámica Cultural Del Centro Oeste y Sus Relaciones Con Áreas Aledañas Argentinas y Chilenas.” In *Actas del VII Congreso Nacional de Arqueología Chilena II*, edited by H. N. Fernández, 532–560. Santiago Museo Nacional de Historia Natural, Sociedad Chilena de Arqueología
- Lagiglia, H. 1997. *Arqueología De Cazadores-Recolectores Cordilleranos De Altura*. San Rafael: Ediciones Ciencia y Arte.
- Lagiglia, H. 2001. “Los Orígenes De La Agricultura En La Argentina.” In *Historia Argentina Prehispánica*, edited by E. E. Berberian and A. E. Nielsen, 41–81. Córdoba: Editorial Brujas.
- Lagiglia, H., G. Neme, and A. Gil. 1994. “Informe De Los Trabajos De Campo En El Sitio El Indígena.” In *Actas y Memorias del XI Congreso Nacional de Arqueología Argentina*, edited by El Congreso Nacional de Arqueología Argentina, 116–118. San Rafael: Provincia de Mendoza, Departamento de San Rafael.
- Lahr, M. M., and R. Foley. 1994. “Multiple Dispersals and Modern Human Origins.” *Evolutionary Anthropology: Issues, News, and Reviews* 3: 48–60.
- Lamy, F., C. Rühlemann, D. Hebbeln, and G. Wefer. 2002. “High- and Low-Latitude Climate Control on the Position of the Southern Peru-Chile Current During the Holocene.” *Paleoceanography* 17: 16.1–16.10.
- Leveau, P., and K. Walsh. 2005. “Population Sequences in a High Altitude Alpine Environment: Archaeological Sites and Historical and Environmental Time.” *International Journal of Anthropology* 20: 155–171.
- Llano, C. 2010. “Aprovechamiento De Recursos Vegetales Entre Las Sociedades Cazadoras-Recolectoras Del Sur De Mendoza.” Ph.D. diss., Universidad Nacional del Comahue, Neuquén.
- Llano, C. 2014. “The Exploitation of Plant Resources by Hunter-Gatherer Societies in Southern Mendoza, Argentina.” *Darwiniana* 2: 96–111.
- Llano, C., G. Neme, and C. T. Michieli. 2011. “Plant Use Intensification among Hunter-Gatherers in the Diamante River Basin, Argentina.” *Before Farming* 2: 1–15.
- Losey, A. 2013. “Risk and Climate at High Elevation: A Z-Score Model Case Study for Prehistoric Human Occupation of Wyoming’s Wind River Range.” Master’s thesis, Utah State University, Logan.
- Lozny, L. R., ed. 2013. *Continuity and Change in Cultural Adaptation to Mountain Environments, from Prehistory to Contemporary Threats*. New York: Springer Science+Business Media.
- Lyman, R. L. 1994. *Vertebrate Taphonomy*. New York: Cambridge University Press.
- Mäkinen, T. M. 2007. “Human Cold Exposure, Adaptation, and Performance in High Latitude Environments.” *American Journal of Human Biology* 19: 155–165.
- Markgraf, V. 1983. “Late and Postglacial Vegetational and Paleoclimatic Changes in Subantarctic, Temperate and Arid Environments in Argentina.” *Palynology* 7: 43–70.
- Martin, A. C., and W. D. Barkley. 1973. *Seed Identification Manual*, Berkeley: University of California Press.
- Mauquoy, D., M. Blaauw, B. van Geel, A. Borromei, M. Quattrocchio, F. M. Chambers, and G. Possnert. 2004. “Late Holocene Climatic Changes in Tierra Del Fuego Based on Multiproxy Analyses of Peat Deposits.” *Quaternary Research* 61: 148–158.
- Metcalfe, D., and K. T. Jones. 1988. “A Reconsideration of Animal Body-Part Utility Indices.” *American Antiquity* 53: 486–504.
- Moore, K. M. 1998. “Measures of Mobility and Occupational Intensity in Highland Peru.” In *Seasonality and Sedentism, Archaeological Perspectives from Old and New World Sites*, edited by T. R. Rocek and O. Bar-Yosef, 181–197. Cambridge: Harvard University.
- Morgan, C. 2006. “Late Prehistoric Territorial Expansion and Maintenance in the South-Central Sierra Nevada, California.” Ph.D. diss., University of California, Davis.
- Morgan, C. 2009. “Climate Change, Uncertainty and Prehistoric Hunter-Gatherer Mobility.” *Journal of Anthropological Archaeology* 28: 382–396.
- Morgan, C. 2015. “Is It Intensification Yet? Current Archaeological Perspectives on the Evolution of Hunter-Gatherer Economies.” *Journal of Archaeological Research* 23: 1–51.
- Morgan, C., R. Adams, and A. Losey. 2012. “High Altitude Residential Occupations in Wyoming’s Wind River Range.” *North American Archaeologist* 33: 35–79.
- Morgan, C., R. L. Bettinger, and M. Giambastiani. 2014a. “Aboriginal Alpine Ceremonialism in the White Mountains, California.” *Journal of California and Great Basin Anthropology* 34: 153–171.
- Morgan, C., A. Losey, and L. Trout. 2014b. “Late Holocene Paleoclimate and Tree-Line Fluctuation in Wyoming’s Wind River Range, USA.” *The Holocene* 24: 209–219.
- Muñoz, W., A. Prina, and G. Alfonso. 2012. “Flora Altoandina De La Reserva Laguna Del Diamante (Mendoza, Argentina).” *Chloris Chilensis* 15: (online), available at <http://www.chlorischile.cl/>.

- Nash, R. B. 2012. "The Role of Maize in Low-Level Food Production among Northern Peripheral Fremont Groups in the Northeastern Uinta Mountains of Utah". Ph.D. diss., University of California, Davis.
- Navarro, D., and C. Whitlock. 2010. "Changes in Climate, Vegetation and Fire Regimes in SW Mendoza, Argentina over the Last 6400 Cal-Yr-Bp: Laguna El Sosneado Record." In *Second International LOTRED-South America Symposium: Reconstructing Climate Variations in South America and the Antarctic Peninsula over the Last 2000 Years*, edited by A. Rivera, D. Christie, R. Villalba, and M. Grossjean, 195. Valdivia: PAGES and Facultad de Ciencias Forestales y Recursos Naturales, Universidad Austral de Chile.
- Neme, G. 2002. "Arqueología Del Alto Valle Del Río Atuel: Modelos Problemas y Perspectivas En El Estudio De Las Regiones De Altura Del Sur De Mendoza." In *Entre Montañas y Desiertos: Arqueología Del Sur De Mendoza*, edited by A. Gil and G. Neme, 65–83. Buenos Aires: Sociedad Argentina de Antropología.
- Neme, G. 2007. *Cazadores-Recolectores De Altura En Los Andes Meridionales: El Alto Valle Del Río Atuel*. B.A.R. 1591. Oxford: B.A.R.
- Neme, G. 2016. "El Indigino and High-Altitude Human Occupation in the Southern Andes." *Latin American Antiquity* 27: 96–114.
- Neme, G., and A. Gil. 2008. "Biogeografía Humana En Los Andes Meridionales: Tendencias Arqueológicas En El Sur De Mendoza." *Chungara* 40: 5–185.
- Neme, G., and A. Gil. 2009. "Human Occupation and Increasing Mid-Holocene Aridity: Southern Andean Perspectives." *Current Anthropology* 50: 149–163.
- Neme, G., and A. Gil. 2012. "El Registro Arqueológico Del Sur De Mendoza En Perspectiva Biogeográfica." In *Paleoecología Humana En El Sur De Mendoza. Perspectivas Arqueológicas*, edited by G. Neme and A. Gil, 254–279. Buenos Aires: Publicaciones de la Sociedad Argentina de Antropología.
- Neme, G., A. Gil, C. Otaola, and M. Giardina. 2013. "Resource Exploitation and Human Mobility: Trends in the Archaeofaunal and Isotopic Record from Central Western Argentina." *International Journal of Osteoarchaeology* 25: 866–876.
- Otaola, C. 2014. "Zooarqueología En La Cordillera Del Sur De Mendoza: Un Enfoque Tafonómico." Ph.D. diss., Universidad Nacional de Buenos Aires.
- Otaola, C., S. Wolverson, M. A. Giardina, and G. Neme. 2015. "Geographic Scale and Zooarchaeological Analysis of Late Holocene Foraging Adaptations in Western Argentina." *Journal of Archaeological Science* 55: 16–25.
- Pacheco Torres, V. R., A. J. A. Enciso, and E. S. Porras. 1986. *The Osteology of South American Camelids*. Los Angeles: Cotsen Institute of Archaeology.
- Phillipson, D. W. 1977. "The Excavation of Gobedra Rockshelter." *Azania* 12: 53–82.
- Planella, M. T., and B. T. A. 2004. "Inicios De Presencia De Cultígenos En La Zona Central De Chile, Períodos Arcaico y Agroalfarero Temprano." *Chungara* 36: 387–399.
- Reimer, P. J., E. Bard, A. Bayliss, J. W. Beck, P. G. Blackwell, C. B. Ramsey, C. E. Buck, H. Cheng, R. L. Edwards, M. Friedrich, P. M. Grootes, T. P. Guilderson, H. Haflidason, I. Hajdas, C. Hatté, T. J. Heaton, D. L. Hoffmann, A. G. Hogg, K. A. Hughen, K. F. Kaiser, B. Kromer, S. W. Manning, M. Niu, R. W. Reimer, D. A. Richards, E. M. Scott, J. R. Southon, R. A. Staff, C. S. M. Turney, and J. v. d. Plicht. 2013. "Intcal13 and Marine 13 Radiocarbon Age Calibration Curves, 0–50,000 Years Cal Bp." *Radiocarbon* 55: 1869–1887.
- Reinhard, J. 2002. "A High Altitude Archaeological Survey in Northern Chile." *Chungara* 34: 85–99.
- Rhode, D. in press. "Plant Macrofossil Assemblages from Alta Toquima." In *The Archaeology of Monitor Valley. 4. Alta Toquima and the Mt. Jefferson Complex*, edited by D. H. Thomas. New York: American Museum of Natural History Papers.
- Rick, J. W. 1980. *Prehistoric Hunters of the High Andes*. New York: Academic Press.
- Rick, J. W. 1988. "The Character and Context of Highland Pre-ceramic Society." In *Peruvian Prehistory*, edited by R. W. Keatinge, 3–40. New York: Cambridge University Press.
- Roig, F. 1960. *Bosquejo Fitogeográfico De Las Provincias De Cuyo*. Mendoza: Comité Nacional para el estudio de las regiones áridas y semiáridas. Subcomité Cuyo. No. 3.
- Roig, V. 1972. "Esbozo General Del Poblamiento Animal De La Provincia De Mendoza." *Boletín de la Sociedad Argentina de Botánica* 13: 81–88.
- Sanhueza, L., F. Falabella, E. Fonseca, and O. Andonje. 2004. "Aplicación De Análisis De Pastas Macroscópicas, Petrográficos y De Composición De Elementos Químicos Al Problema De La Procedencia De Cerámica En El Período Alfarero Temprano De Chile Central y Cuyo, Argentina." *Estudios Atacameños* 28: 121–132.
- Scharf, E. A. 2009. "Foraging and Prehistoric Use of High Elevations in the Western Great Basin: Evidence for Seed Assemblages at Midway (Ca-Mno-2169), California." *Journal of California and Great Basin Anthropology* 29: 11–27.
- Schiffer, M. B. 1987. *Formation Processes of the Archaeological Record*. Albuquerque: University of New Mexico Press.
- Simonson, T. S. 2015. "Altitude Adaptation: A Glimpse through Various Lenses." *High Altitude Medicine & Biology* 16: 125–137.
- Singh, S. P., P. Gepts, and D. G. Debouck. 1991. "Races of Common Bean (*Phaseolus Vulgaris*, Fabaceae)." *Economic Botany* 45: 379–396.
- Smith, C. S., and L. M. McNees. 1999. "Facilities and Hunter-Gatherer Long-Term Land Use Patterns: An Example from Southwest Wyoming." *American Antiquity* 64: 117–136.
- Smith, C. S., and L. M. McNees. 2011. "Persistent Land Use Patterns and the Mid-Holocene Housepits of Wyoming." *Journal of Field Archaeology* 36: 298–311.
- Smith, W. K., M. J. Germino, D. M. Johnson, and K. Reinhardt. 2009. "The Altitude of Alpine Treeline: A Bellwether of Climate Change Effects." *Botanical Review* 75: 163–190.
- Solbrig, P., P. Baker, and D. Ives. 1984. "UNESCO State of Knowledge Report on Andean Ecosystems." *Mountain Research and Development* 4: 97–102.
- Steele, J. 2010. "Radiocarbon Dates as Data: Quantitative Strategies for Estimating Colonization Front Speeds and Event Densities." *Journal of Archaeological Science* 37: 2017–2030.
- Stevens, N. A. 2005. "Changes in Prehistoric Land Use in the Alpine Sierra Nevada: A Regional Exploration Using Temperature-Adjusted Obsidian Hydration Rates." *Journal of California and Great Basin Anthropology* 25: 187–205.
- Stingle, H., and K. Garleff. 1985. "Glacier Variations and Climate of the Late Quaternary in the Subtropical and Mid-Latitude Andes of Argentina." *Aeitschrift Fur Gletscherkunde* Band 21: 225–228.
- Stirn, M. 2014. "Modeling Site Location Patterns Amongst Late-Prehistoric Villages in the Wind River Range, Wyoming." *Journal of Archaeological Science* 41: 523–532.
- Stuiver, M., and P. J. Reimer. 1993. "Extended 14c Database and Revised Calib Radiocarbon Calibration Program (Version 7.0)." *Radiocarbon* 35: 215–230.
- Thomas, D. H. 1982. *The 1981 Alta Toquima Village Project: A Preliminary Report*. Desert Research Institute Social Sciences and Humanities Publications 27. Reno: Desert Research Institute.
- Thomas, D. H. 1994. "Chronology and the Numic Expansion." In *Across the West: Human Population Movement and the Expansion of the Numa*, edited by D. B. Madsen and D. Rhode, 56–61. Salt Lake City: University of Utah Press.
- Trout, L. 2015. "Subsistence, Mobility and Intensity of Residential Site Use: Results of Flaked Stone Analysis at High Rise Village." Master's thesis, University of Nevada, Reno.
- Volkheimer, W. 1978. *Descripción Geológica De La Hoja 27 B, Cerro El Sosneado*. Buenos Aires: Servicio Geológico Nacional.
- Walsh, K., S. Richer, and J.-L. d. Beaulieu. 2006. "Attitudes to Altitude: Changing Meanings and Perceptions Within a 'Marginal' Alpine Landscape—the Integration of Paleoecological and Archaeological Data in a High-Altitude Landscape in the French Alps." *World Archaeology* 38: 436–454.
- Watkins, R. 2000. "Site 42dc823: Evidence for High Elevation Foraging in the Uinta Mountains." *Utah Archaeology* 13: 45–51.
- Weninger, B., O. Jöris, and U. Danzeglocke. 2015. *Calpal-2015. Cologne Radiocarbon Calibration and Palaeoclimate Research Package*. Accessed October 5, 2015. <http://www.calpal.de/>.
- Williams, A. N. 2012. "The Use of Summed Radiocarbon Probability Distributions in Archaeology: A Review of Methods." *Journal of Archaeological Science* 39: 578–589.
- Williams, P. R. 2006. "Agricultural Innovation, Intensification, and Sociopolitical Development: The Case of Highland Irrigation Agriculture on the Pacific Andean Watersheds." In *Agricultural*

- Strategies*, edited by J. Marcus and C. Stanish, 309–333. Los Angeles: Cotsen Institute of Archaeology, University of California.
- Wortmann, C. S. 2006. “Phaseolus Vulgaris L. (Common Bean).” In *PROTA (Plant Resources of Tropical Africa / Ressources végétales de l’Afrique tropicale), Volume 1, Cereals and Pulses*, edited by M. Brink and G. Belay, 146–151. Wageningen: Earthprint Limited.
- Wright, G. A., S. Bender, and S. Reeve. 1980. “High Country Adaptations.” *Plains Anthropologist* 25: 181–197.
- Zárate, M., A. Gil, and G. Neme 2010. *Condiciones Paleoambientales y Ocupaciones Humanas Durante La Transición Pleistoceno-Holoceno y Holoceno De Mendoza*. Buenos Aires: Publicaciones de la Sociedad Argentina de Anthropologia.
- Zárate, M., G. Neme, and A. Gil. 2005. “Mid Holocene Paleoenvironments and Human Occupation in Southern South America.” *Quaternary International* 132: 1–3.
- Zhu, R. X., R. Potts, F. Xie, K. A. Hoffman, C. L. Deng, C. D. Shi, Y. X. Pan, H. Q. Wang, R. P. Shi, Y. C. Wang, G. H. Shi, and N. Q. Wu. 2004. “New Evidence on the Earliest Human Presence at High Northern Latitudes in Northeast Asia.” *Nature* 431: 559–562.