Tracy Martens

Textile fibres from the Caleta Vitor Archaeological Complex, northern Chile

Abstract
This article examines fibre procurement, fibre technologies and type preferences at northern Chile's Caleta Vitor archaeological complex – a coastal site with archaeological deposits representing more than 10,000 years of occupation. Data obtained from textile analysis, stable isotopes, and historical documents provided evidence of a marine subsistence economy heavily reliant on composite fibre implements, highlighting the early predominance of plant fibres, along with camelid fibres and the introduction of *Gossypium barbadense* (cotton) in the Formative Period. The study also provides evidence of a previously unknown local camelid fibre source, challenging the long-held hypothesis that camelid fibre at low altitude sites is a proxy for trade with high altitude populations

Key words: Archaeological textiles, perishable artefacts, Chile, marine subsistence, stable isotope analysis

Introduction

During the Late Pleistocene (approximately 13,000 BP), people arrived on Chile's hyper-arid northern coast with an established marine-focused economy dependent on fishing gear, including hooks, lines, lures, and points. While the bone, stone and timber components of some composite tools have been examined in detail, fibre components have received little attention. A more complex textile tradition that developed in the region during the Formative Period (4,000 BP to 1,500 BP) has been identified at nearby sites (Azapa 70). However, the geographical extent of that technological tradition and detailed chronologies for it are scant. This bias persists despite the Atacama desert's conditions conducive to the preservation of perishable artefacts. The study reported here aims to provide a detailed analysis of these under-researched fibre technologies, clarify divergent models of fibre technology and material choices, identify culturally specific textile traditions, and identify provenance for fibre materials from the Caleta Vitor archaeological complex on Chile's far northern coast.

Background

Chinchorro fibre processing technologies included twining, cordage (vegetal and animal fibre) and net production. These expertly executed techniques can be broadly described as simple because they do not require specialised tools. Notwithstanding such simplicity, these fibre technologies made life in the harsh Atacama possible by facilitating the extraction of marine resources that provided an estimated 80% of dietary protein (Roberts et al. 2013). While it is generally accepted that the Chinchorro people exploited locally available raw materials in both craft and subsistence economies, there is a divergence of opinion regarding when different raw materials were in use. Some researchers suggest that cotton and vegetal fibre dominated the Archaic Period (13,000 BP to 4,000 BP) whereas others suggest camelid and vegetal fibre were the earliest available materials, with the former typically identified as non-local.

These divergent opinions have socio-political and economic implications. *Gossypium barbadense* (cotton) is indigenous to northern Peru and southern Ecuador.

Processed cotton is not documented in southern Peru until 4,150 Cal BP (Beresford-Jones et al. 2017) which is still several thousand years earlier than suggested for northern Chile. These complications require a reconsideration of the established distribution of native cotton on the west coast of South America or consider the possibility that long-distance trade routes were in place during the early Holocene. The alternative view implies that camelid fibre along with vegetal fibres were in use during the early Holocene. This notion has been criticised because of a lack of camelids in modern northern Chilean coastal areas and little knowledge of prehispanic camelid grazing areas. This question extends through to the Late Period (600 BP to 500 BP), when Spanish invaders irreparably disrupted traditional herding practices, leading to the conclusion that camelid husbandry was solely a highland activity and that the presence of camelid fibre at coastal sites is a proxy for highland trade or long-distance hunting.

Through the analysis of more complex fibre structures from Caleta Vitor, the research aimed to establish local participation in the local textile tradition featuring balanced interlacing, warp faced fabrics, warp stripes and weft faced elaborations (approximately 3,000 BP) (Ulloa 1981a; 1981b; Cassman 1997). This tradition is believed to have spanned much of the Chinchorro's cultural area - the coastal region between the Rio Loa and the Azapa Valley. However, more detailed regional studies outside the Azapa Valley are needed to confirm the existence of this tradition across that area.

On a larger scale, this research seeks to clarify external influences on the local fibre industry. This applies particularly to the Late Period as Inka artefacts at Caleta Vitor were sparse compared to sites in the nearby Azapa/Lluta valley. The Inka are thought to have administered the north of Chile through *tambos* in the Arica highlands with little direct interest in the

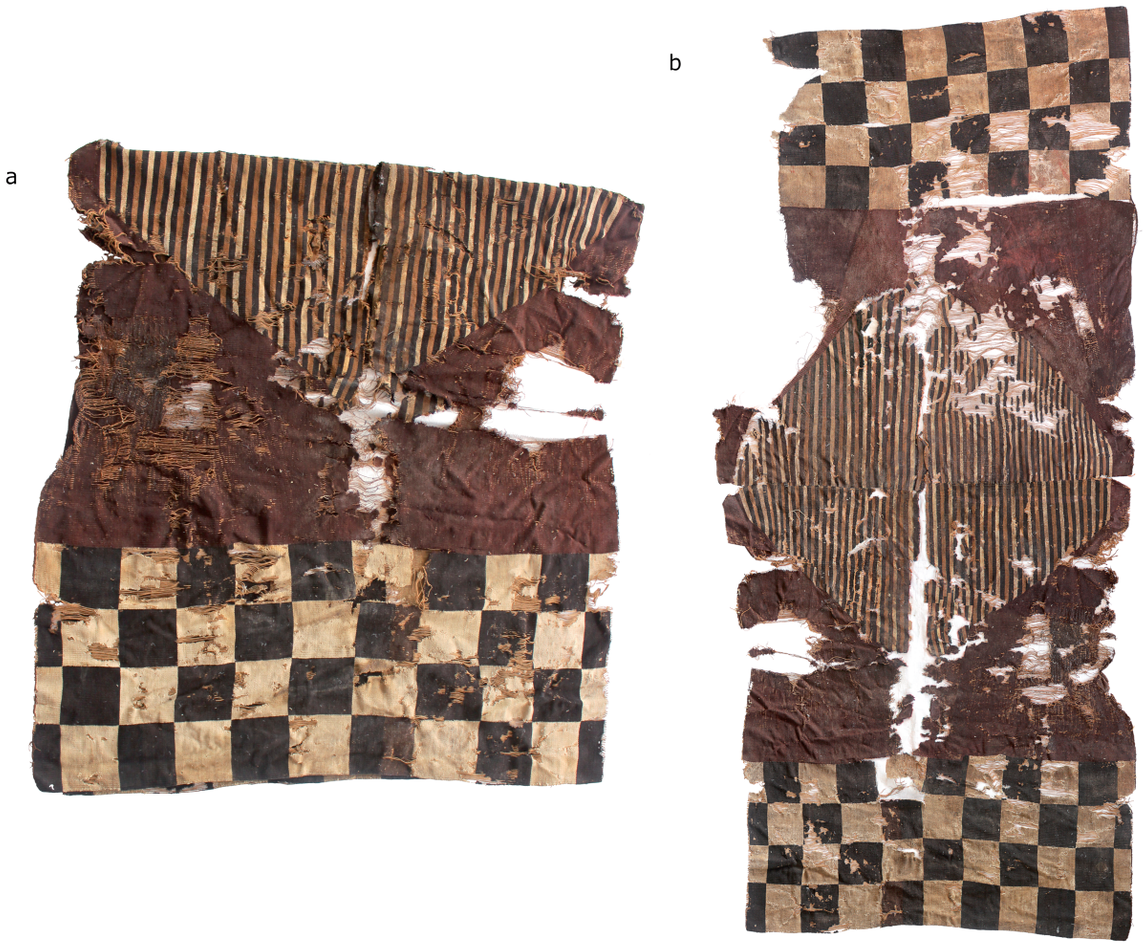

Fig. 1: The unku with a camelid fibre weft and a cotton warp: a – folded in half; and b – laid flat, with the neck opening at the centre (Image: Courtesy of Paola Salgado)

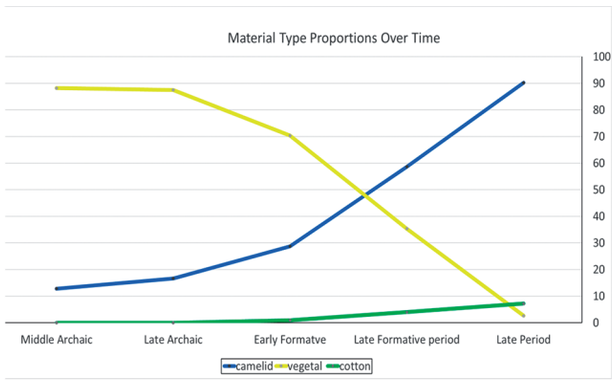

Fig. 2: Material type proportions over time (Image: Tracy Martens)

area owing to its small and dispersed population, lack of highly organised craft production, and limited potential for intensive maize agriculture or camelid husbandry. This paradigm was challenged by the discovery of an Inka *unku* (fig. 1) at the site, a fine, tapestry woven, camelid fibre tunic and powerful symbol of Inka administrative influence.

Methodology

More than 1,000 fibre artefacts were identified and recorded from five prescribed zones comprising middens, occupation areas, burials and rock art (Carter 2016). Artefacts were dated to the Middle through Late Archaic (6,000 BP to 4,000 BP), Formative (4,000 BP to 1,500 BP) and Late Period (600 BP to 500 BP), with no fibre items representing the Middle Horizon or Late Intermediate Period. Fibre structures were initially described and identified at the Instituto de Alta Investigación de Arqueología y Paleoambiente (Universidad de Tarapacá), in accordance with conventions established by Emery (1980). Microscopic analysis and 13C/12C and 15N/14N ratios were analysed at the Stable Isotope Laboratory of the Research School of Biology (Australian National University) on a Micromass Isochrom Continuous Flow Isotope Ratio Monitoring Mass Spectrometer coupled to an Elemental Analyzer.

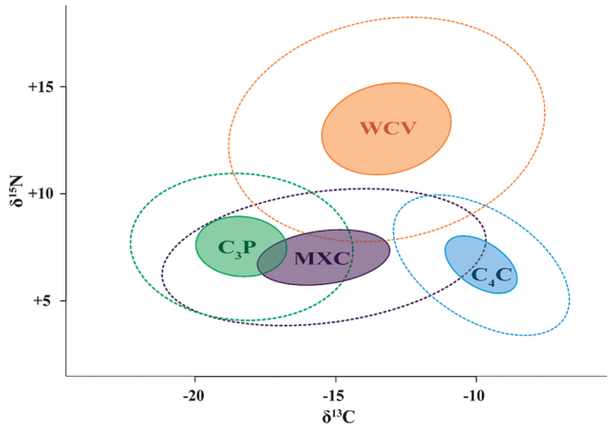

Fig. 3: Estimated isotope niche (SEAc) from the distribution of carbon and nitrogen values of referential archaeological camelid groups (Szpak et al. 2016) for the western Andean slope. Dashed ellipses - basic standard ellipses (SEA) (Image: Gayo et al. 2020)

Results and discussion

While no fibre items were recovered from the earliest occupation layers, indirect evidence of fibre processing technology in the Early Archaic was identified. A fine shell bead (less than 5 mm) and a multitude of remains of net-caught fish species indicate cordage production. Middle Archaic (7,500 BP to 6,000 BP) layers produced twisted, spun, plied and Z-direction twined fibre artefacts made of vegetal fibre and later of camelid fibre. The overwhelming majority of artefacts were vegetal fibre, probably composed of locally available sedges (*Schoenoplectus* spp.) (fig. 2). Cotton artefacts were not recovered from the Archaic layers (13,000 BP to 4,000 BP). During the Early Formative Period (4,000 BP to 2,500 BP), there was a decline in vegetal fibre and an increase in camelid fibre. A highly degraded fragment of cotton yarn, dated to approximately 3,360 cal BP, was found in a unit with unprocessed cotton in excellent condition (Martens et al. 2019). Further research is required to determine if the degraded condition of the yarn is a result of pre- or post- depositional factors.

At Caleta Vitor, the Early Formative Period (4,000 BP to 1,500 BP) is marked by significant changes such as the appearance of ceramics, new burial practices, the decline of the Chinchorro culture, and the first appearance of camelid droppings without any evidence for camelid butchering or consumption on site (Carter 2016). Despite the introduction of new technologies and materials, fibre processing technologies remained relatively unchanged until the Late Formative Period when loom woven textiles appear. This coincided with a marked change in raw materials; camelid fibre became the most common material, vegetal fibre fell out of favour and cotton was present but rare (Martens et al. 2019). The increasing trend towards camelid fibre usage and decreasing reliance on vegetal fibres continued through the Late Period when camelid fibre became the most common fibre by a significant margin (fig. 2). Vegetal fibre yarns never achieved the same uniformity (spin and ply direction, dimensions and angle and tightness of twist) as camelid fibre processing. This change may

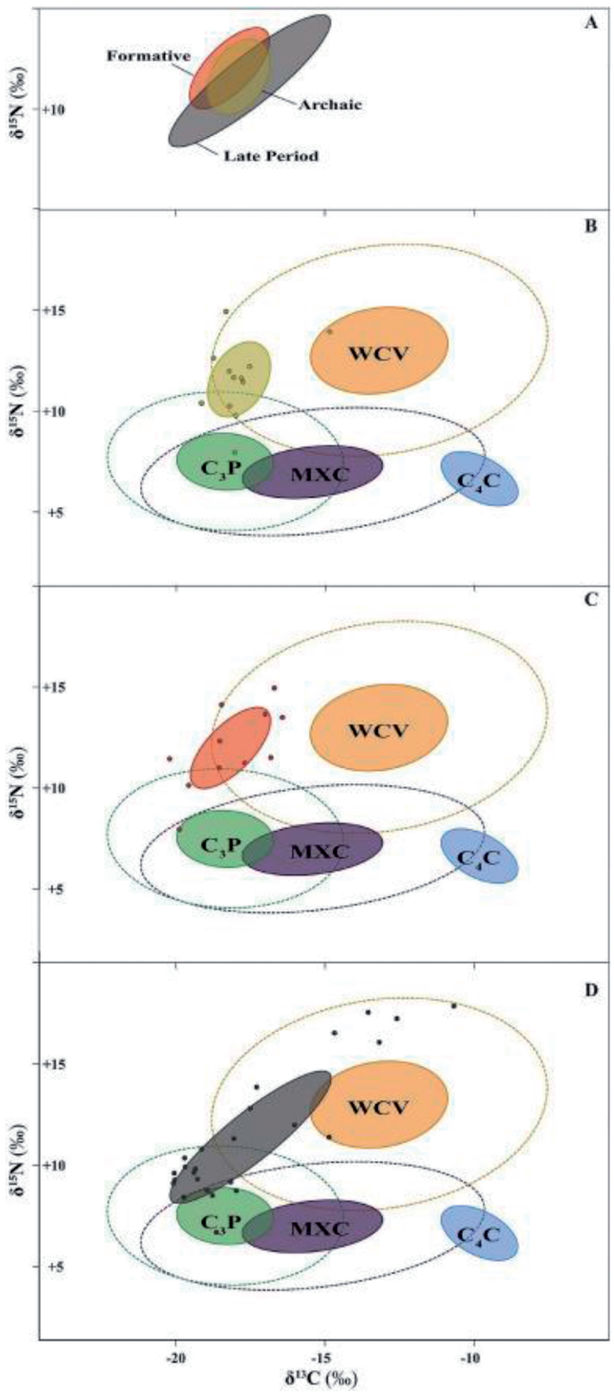

Fig. 4: Estimated isotope niche (SEAc) from the distribution of carbon and nitrogen values of referential camelid groups and Archaic (B), Formative (C) and Late Period (D) populations. Dashed cyan and purple lines: standard ellipses (SEA) for archaeological camelids populations raised in highlands and low-elevation C3/C4 crop-fields (Image: Gayo et al. 2020)

reflect the physical characteristics of particular vegetal fibres that exhibit a predilection of twist direction called the fibrillar orientation (Bergfjord and Holst 2010) rather than differential treatment of the two materials. Confirming this supposition will require experimentation.

The style and technical attributes of textile fragments from the site's Late Formative Period (2,500 BP to 1,500 BP) deposits compare favourably with attributes typical of the broader textile tradition that stretched between the Azapa to Loa River valleys, where the Chinchorro tradition had previously dominated (Ulloa 1981b). Caleta Vitor's participation in this regional tradition is significant as there are just a handful of confirmed sites outside the Azapa Valley. Whilst no fibre items from Middle Horizon or Late Intermediate Period units were recovered, these technologies continued through the Late Period and were probably also used during unrepresented periods.

The unku

The unexpected identification of an Inka *unku* suggests a more formal relationship with the Inka empire that included direct administration than was previously recognised (fig. 1). Symbolically, *unku* were gifted to local leaders to convey the direct power of the Sapa Inka and ultimately, played an important role in the expansion of the empire by vesting legitimacy in local administrators. The unprecedented discovery is significant to the developing understanding of Inka activity on the northern Chilean coast, a region previously believed peripheral to Inka interest. Because typical prerequisites of Inka involvement are absent at the site, the presence of the *unku* along with increased volumes of discarded pottery, evidence of increased marine resource extraction, population increase and camelid droppings at the site probably represent state involvement and represent a new set of proxies for Inka interaction on the northern Chilean coast (Martens 2019).

Camelid fibre acquisition

For the contextualisation of 48 camelid fibre samples from the Archaic Period, Formative Period and Late Period artefacts, established isotopic signatures were used in order to detect camelid grazing regimes from the western Andean slope (Szpak et al. 2016). The regimes include mixed irrigated cultigens (MXC), comprising irrigated cultigens grown in the lowlands, wild coastal vegetation (WCV), comprising wild plants from fog oases at mid and low altitudes (extreme hyperarid plus marine influence), cultivated C4 crops (C4C) and irrigated maize crops, and high-elevation

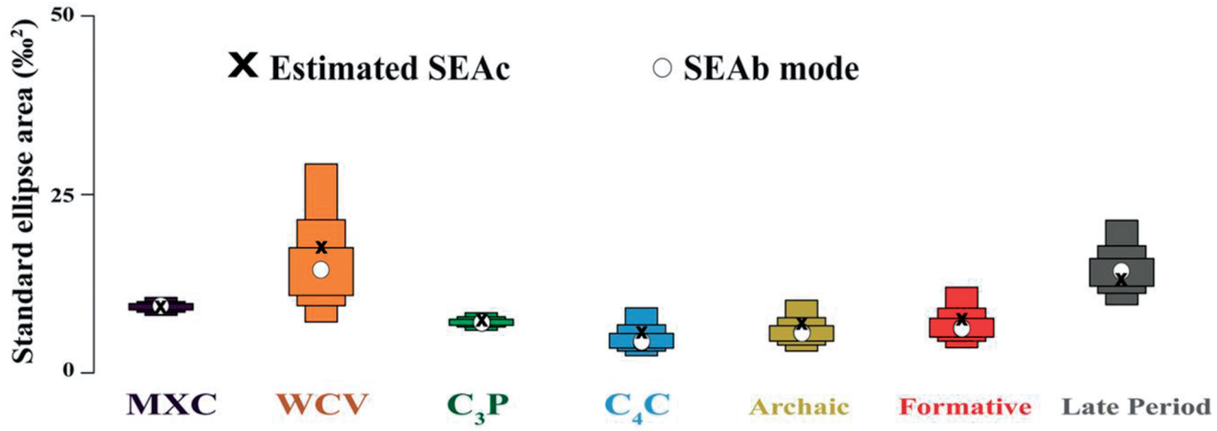

Fig. 5: Posterior Bayesian estimates for Standard Ellipse areas for archaeological referential groups and Caleta Vitor assemblages showing the SEAb mode and corresponding 50%, 95% and 99% credible intervals of posterior distributions of 10,000 simulations (Image: Gayo et al. 2020)

C3 pastures (C3P) composed of wild plants from high-elevation environments (*puna* and/or *bofedales*) (fig. 3). Based on the generally accepted archaeological paradigm that camelid fibres are a highland resource, the samples from all three periods were expected to reflect C3 rich diets typical of the high Andean steppe as represented by the C3P regime. However, the results indicate a diet reflecting wild coastal vegetation.

Statistically, all three time periods are indistinguishable, overlapping with both C3P and WCV regimes (fig. 4). There is considerably more overlap with WCV, indicating feeding on coastal lomas vegetation with the possibility that some animals were fed on high-altitude resources before being moved to the lowlands and fed WCV. Alternatively, the overlap with C3P could represent variability within the WCV regime (intra-regime variability) as there is little overlap with the core C3P niche, indicating this high-altitude niche is not strongly represented in the samples (fig. 4). The Late Period group niche is wider but overlaps with the other time period groups, indicating that they exploited similar dietary niches (fig. 5). Differential variation could represent differences in dietary niche, sample size variation and δ15N variation between one depleted individual and five very enriched individuals (Gayo et al. 2020).

While the Late Period niche is clearly wider than other time periods (indicating a more varied diet, as with the WCV regime), the Archaic and Formative Periods are equivalent and narrower (indicative of a less diverse diet) than the reference groups. The overlaps clearly indicate that camelid populations from all three represented time periods occupied equivalent isotope (trophic) niches likely from low-altitude WCV resources found in fog oases or lomas formations (Gayo et al. 2020). Contrary to previously established models for camelid fibre procurement, the 48 camelid fibre samples showed that they were available from low/mid-altitude sources rather than a proxy for highland contact, Inka dominion or long-distance trade. This is a significant challenge to established trade models because camelid fibre has been a proxy for Inka/ highland contact and trade at coastal sites for decades.

Conclusions

People arrived at Caleta Vitor with knowledge of plant processing and yarn production and quickly developed or adopted animal fibre processing. Locally available plant fibre slowly gave way to camelid fibre which became overwhelmingly dominant by the Late Period. Surprisingly, the population was either unable or unwilling to adopt cotton as a major fibre source, unlike coastal populations to the north, in Peru where cotton processing precedes ceramic production. Fibre implements such as nets, lines and cords were essential to the marine subsistence economy of the site. More complex technologies developed or were adopted over the time periods analysed. However, the people of Caleta Vitor continued to utilise simple and effective textile and yarn production techniques, evident in the earliest layers. New technologies including the backstrap loom were introduced in the Formative Period, that precipitated the development of a local textile tradition. This was characterised by warp-faced structures among other techniques. Finally, when

combined, increases in population, resource use and changes in material culture as well as the discovery of an *Inka unku* and isotopic evidence for camelid fibre procurement outside the highlands strongly suggest that further research is needed to clarify highland/coastal trade and political relations in the region.

Acknowledgment
I would like to thank my supervisor Judith Cameron, the Instituto de Alta Investigación of the Universidad de Tarapacá, C. Santoro, D. Valenzuela, E. Jolie, E. Gayo and T. Lynch for their valuable comments and contributions to my PhD. This research was supported by an Australian Government Research
Training Program Scholarship and the Chilean National Science Foundation Project 1150763 led by Claudio Latorre.

Bibliography

Beresford-Jones, D., Pullen, A., Chauca, G., Cadwallader, L., García, M., Salvatierra, I., Whaley, O., Vásquez, V., Arce, S., Lane, K. and French, C. (2017) Refining the Maritime Foundations of Andean Civilization: How Plant Fiber Technology Drove Social Complexity During the Preceramic Period. *Journal of Archaeological Method and Theory 25*(2), 393–425. https://doi.org/10.1007/s10816-017-9341-3

Bergfjord, C. and Holst, B. (2010) A procedure for identifying textile bast fibres using microscopy, *Ultramicroscopy* 110, 9, 1192–1197.

Cassman, V. (1997) *A Reconsideration of Prehistoric Ethnicity and Status in Northern Chile: The Textile Evidence*. PhD dissertation. Tempe: Department of Archaeology, Arizona State University.

Emery, I. (1980) *The Primary Structures of Fabrics*. Washington: Thames and Hudson.

Gayo, E. M., Martens, T., Stuart-Williams, H., Fenner, J., Santoro, C. M., Carter, C. and Cameron, J. (2020) Procurement of camelid fiber in the hyperarid Atacama Desert coast: Insights from stable isotopes. *Quaternary International* 548, 71–83.

Martens, T. (2019) *Fiber Technology from the Caleta Vitor Archaeological Complex, northern Chile.* PhD Thesis. Canberra: Archaeology, Department of Culture, History and Language, Australian National University.

Martens, T., Correa-Lau, J., Santoro, C. M., Carter, C. and Cameron, J. (2021) An Inka Unku from Caleta Vitor Bay, Northern Chile. *Latin American Antiquity* 32(1), 201–208.

Roberts, A., Donald, P., Petruzzelli, B., Carter, C., Westaway, M., Santoro, C., Swift, J., Maddern, T., Jacobsen, G., Bertuch, F. and Rothhammer, F. (2013) Retention of hunter-gatherer economies among maritime foragers from Caleta Vitor, northern Chile, during the late Holocene: Evidence from stable carbon and nitrogen isotopic analysis of skeletal remains. *Journal of Archaeological Science* 40(5), 2360–2372.

Szpak, P., Chicoine, D., Millaire, J-F., White, C. D., Parry, R. and Longstaffe, F. J. (2016) Early Horizon camelid management practices in the Nepeña Valley, north-central coast of Peru. *Environmental Archaeology 21*, 230–245.

Ulloa, L. (1981a) Estilos decorativos y formas textiles de poblaciones agromarítimas en el extremo norte de Chile. *Chungara, Revista de Antropología Chilena* 8, 109–136.

Ulloa, L. (1981b) Evolución de la industria textil prehispánica en la zona de Arica. *Chungara, Revista de Antropología Chilena* 8, 97–108.

Author:
martens.tracy@gmail.com