Quaternary International 356 (2015) 4–14

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Timing of occupation and regional settlement patterns revealed by time-series analyses of an archaeological radiocarbon database for the South-Central Andes (16°–25°S)

Eugenia M. Gayo [a, b, *], Claudio Latorre [c, d], Calogero M. Santoro [a, e]

[a] Centro de Investigaciones del Hombre en el Desierto (CIHDE), Av. General Velásquez 1775, Edificio CIHDE, Arica, Chile
[b] Centro de Ciencia del Clima y la Resiliencia (CR)^2, Chile
[c] Departamento de Ecología, Pontificia Universidad Católica de Chile, Alameda 340, Santiago, Chile
[d] Institute of Ecology & Biodiversity (IEB), Casilla 653, Santiago, Chile
[e] Instituto de Alta Investigación (IAI), Universidad de Tarapacá, Antofagasta 1520, Casilla 6-D, Arica, Chile

ARTICLE INFO

Article history:
Available online 1 November 2014

Keywords:
Summed probabilities
Central Andes
Atacama Desert
Palaeodemography
Time-series

ABSTRACT

Developing spatially resolved high-resolution datasets of robust long-term changes in human demography constitutes a major challenge for archaeology. One approach is to use the distribution of summed radiocarbon-age probabilities to infer long-term population dynamics (i.e. palaeodemography). However, these can often be biased by preservation potential, site taphonomy or researcher priorities among other aspects, all of which require large datasets to resolve adequately. For this report, we have created such a dataset for the South-Central Andes (16°–25°S), here termed the South Central Andes Radiocarbon (SCAR) database. SCAR spans the last 15,000 years and incorporates ~1700 ^{14}C-dates from 519 archeological sites reported across an extreme bioclimatic gradient that includes the hyperarid coastal Atacama Desert and adjacent cold, high-elevation Altiplano. Among the possible methodological biases, we first evaluated those related to calibration procedures. Otherwise, changes in summed probability curves show no other relevant biases except for possible research interest/priorities that could be responsible for the gaps in the record from the Bolivian altiplano. Our temporally continuous time-series indicates that prehispanic populations exhibited significant demographic changes during the last 13,100 cal BP. Except for coastal populations; most regions show strongly coordinated demographic fluctuations that follow the same major patterns. Thus, we identified two broad scale population events across the South-Central Andes (Atacama inland, Bolivian Altiplano) from 13,100–4000 cal BP and then from 4000 cal BP to the present. In contrast, the Atacama coastal records suggest a different and more variable occupation pattern over the last 13,460 cal BP, which could be driven by the interaction with oceanographic processes (i.e. upwelling). A widespread major decline at 700 cal BP clearly predates the Spanish colonization and occurs in all of our regions. This widespread decline does not appear to be due to methodological biases, and suggests that a population crash occurred before European occupation. Overall, the SCAR database constitutes a valuable proxy for establishing the long-term dynamics of prehistoric societies that inhabited the western Andean slope. Time-series analyses that use SCAR will shed new light on the demographic and cultural dynamics at different spatial-scales, and help clarify the processes involved in the migrational trajectories and cultural evolution of the peoples that inhabited the South-Central Andes over the last 15,000 years.

1. Introduction

Extensive databases of archaeological radiocarbon dates are important resources for reconstructing prehistoric populations at different spatial–temporal scales (Gkiasta et al., 2003; Gamble et al., 2004; Riede, 2009; Steele, 2009; Gajewski et al., 2011; Johnson and Brook, 2011; Prates et al., 2013). Time-series analyses in particular are dependent on such databases, and have been used to infer patterns and long-term trends in palaeodemography throughout Europe (Fiedel and Kuzmin, 2007; Shennan and Edinborough, 2007; Turney and Brown, 2007; Oinonen et al., 2010; Tallavaara et al., 2010), North America (Hamilton and

* Corresponding author. Centro de Investigaciones del Hombre en el Desierto (CIHDE), Av. General Velásquez 1775, Edificio CIHDE, Arica, Chile.
E-mail address: egayo@cihde.cl (E.M. Gayo).

http://dx.doi.org/10.1016/j.quaint.2014.09.076
1040-6182/

Buchanan, 2007; Buchanan et al., 2008; Munoz et al., 2010; Peros et al., 2010; Steele, 2010; Bamforth and Grund, 2012) and Australia (Lourandos, 1993; Holdaway and Porch, 1995; Turney and Hobbs, 2006; Smith and Ross, 2008; Smith et al., 2008; Williams et al., 2008; Johnson and Brook, 2011).

In South America, palaeodemographic reconstructions based on time-series analyses, were pioneered by Rick (1987). Since then, new efforts have emerged. For example, exploratory studies based on archaeological ^{14}C-dates from the Atacama Desert evince significant fluctuations in coastal and inland population levels throughout the last 13,000 years related to changes in El Niño-Southern Oscillation (ENSO) (Williams et al., 2008) and water availability (Williams et al., 2008; Marquet et al., 2012). Most recently, Méndez (2013) tackled demographic patterns, paleoenvironmental scenarios and chronological differences in early human occupation across Chile during the interval 13,000–7000 cal yrs BP. Similar approaches have been used in Brazil (Bueno et al., 2013), Peru (Rademaker et al., 2013) and south-eastern Argentina (Martínez et al., 2013).

Time-series analyses of radiocarbon data have shed light on the occupation and demographic history of localized regions of South America as well as on the interactions between prehispanic societies and palaeoenvironmental fluctuations, but a comprehensive knowledge of long-term trends at the continental scale requires finely resolved datasets in time and space. Such datasets constitute powerful tools for portraying diversity, linearity and threshold responses to variations in socio-cultural or environmental factors that underlie the structure, dynamics and cultural evolution of prehistoric South American societies. High-resolution sets provide insightful means for identifying convergences/divergences in population and cultural processes between and within different societal groups that have inhabited the continent over the last 13,000 years. Similarly, these can be useful for inferring settlement patterns, exchange, mobility and territorial expansion through time and across different geographic scales, particularly in terms of flows and admixture of populations.

In this study, we present a high spatial and temporal resolution radiocarbon database for the South-Central Andean region (16°–25°S), called the "South Central Andes Radiocarbon database" (SCAR). This repository encompasses over 1700 ^{14}C-dates derived from archaeological sites located in countries that lie across the western Andean slope including Chile, Peru and Bolivia (Fig. 1). The South-Central Andean region offers a profuse, diverse and continuous archaeological record that dates back to the initial occupation of the continent (e.g. Grosjean et al., 2005; Jolie et al., 2011; Salazar et al., 2011; Capriles and Albarracin-Jordan, 2012; Dillehay et al., 2012; Latorre et al., 2013), thereby allowing us to conduct time-series analyses for exploring the long-term population and cultural dynamics of prehistoric societies (e.g. Marquet et al., 2012). Furthermore, the ecophysiographic diversity that characterizes this region provides a unique opportunity for revealing past demographic trends and cultural trajectories within an area of differentiated reliefs and contrasting extreme bioclimatic conditions, from the hyperarid coastal Atacama Desert to the cold high elevation environments of the Altiplano.

We evaluate the potential and suitability of SCAR for extracting information on the past population dynamic and its spatial–temporal variability by reconstructing the long-term demographic history for the South-Central Andes at subcontinental and regional scales over the last 15,000 years. It also helps to highlight data deficiency in certain time periods and regional areas. Time-series analyses based on the examination of the summed probability distribution of calibrated ^{14}C-dates were established from archaeological sites located across the western Andean slope (Fig. 1). Because different methodological factors might influence the temporal distributions of archaeological radiocarbon dates (see

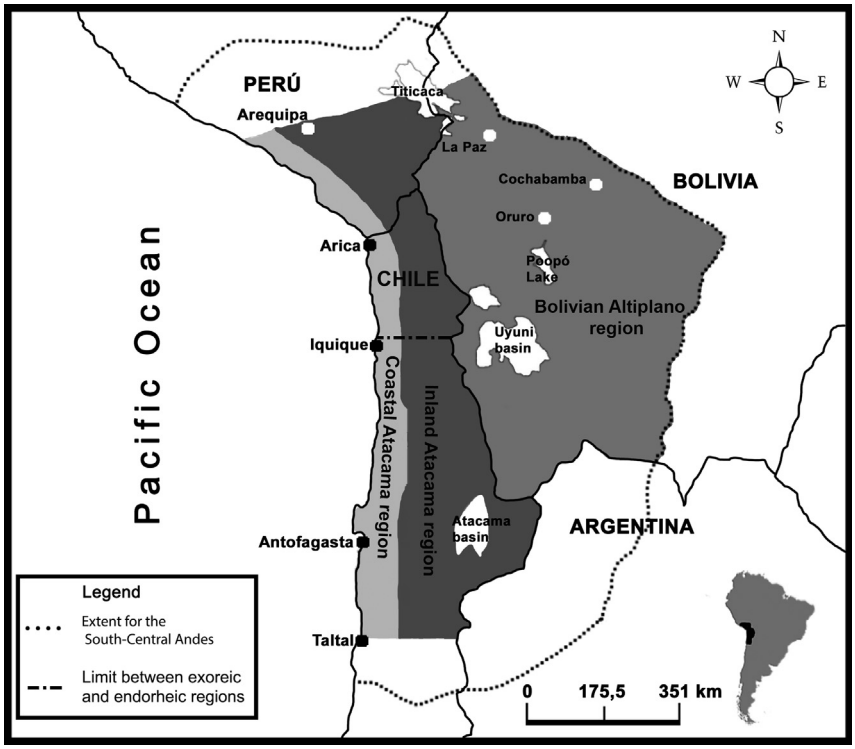

Fig. 1. Map for the South-Central Andes showing the extent of each ecophysiographic region between 16° and 25°S. The dashed line marks the extent of the South-Central Andes (according to Muñoz, 1989).