



# The human occupation of northwestern Patagonia (Argentina): Paleoecological and chronological trends



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## ARTICLE INFO

### Article history:

Available online 29 October 2014

### Keywords:

Palaeoecology  
Archaeology  
Radiocarbon chronology  
Human paleo-demography  
South America  
Northwestern Patagonia

## ABSTRACT

Archaeological radiocarbon databases are being increasingly used as a proxy of past demographic trends. In this paper we compile and analyze an extensive database of paleoecological information and <sup>14</sup>C dates from archaeological sites in northwestern Patagonia (Argentina, South America). On this basis, we assess the regional distribution of human populations since the late Pleistocene, and their relation with the evolution of Patagonian climate and landscapes. We explore the spatial and temporal distribution of evidence and discuss sampling biases affecting the record in different ecological contexts. The analysis is set in the frame of three main ecological regions that have implications for human subsistence: Andean forest, grass steppe, and shrub steppe. The intensity of the archaeological signal differs among these regions through time, being stronger and more homogeneous in the grass steppe. In the Andean forest and the shrub steppe the signal is weaker and even absent during short periods of the middle Holocene. We suggest likely sampling biases contributing to these tendencies, since these three regions present variable research cover and intensity. On the other hand, we also suggest that these differences may reflect variations in the intensity of human occupation, in favor of more attractive environments for hunting (i.e., areas where guanaco are generally more abundant). This macro-regional synthesis of the paleoecology and archaeology of northwestern Patagonia provides a platform for developing future oriented research.

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## 1. Introduction

Starting with the seminal 'Dates as data' paper of Rick (1978), and after two decades of development, radiocarbon series are now increasingly used as a proxy of the intensity of the archaeological signal and, hence, of human demography (e.g., Gamble et al., 2004; Shennan and Edinborough, 2007; Williams, 2012; Martínez et al., 2013; Prates et al., 2013; Williams et al., 2013). Recent developments include the use of taphonomic corrections accounting for the time-dependent preservation of the archaeological record (Surovell et al., 2009), methodological discussions on the analytical steps required to process the data (Steele, 2010; Buchanan et al., 2011), and the proposition of equations translating frequencies of

dates in terms of numeric population reconstructions (Williams, 2013), among others. In this paper we assemble radiocarbon data available for northwestern Patagonia (Argentina, Fig. 1), a region with very discontinuous field sampling and dating. The long-term goal is to assess the regional distribution of human populations since the late Pleistocene, and their relation with the evolution of the Patagonian climate and landscapes, as well as studying the economic and social context for demographic change and/or stability. We consider this work as a first step focused in assembling the database, characterizing its structure and critically assessing its quality and main limitations.

## 2. Present environmental context (35–41°S)

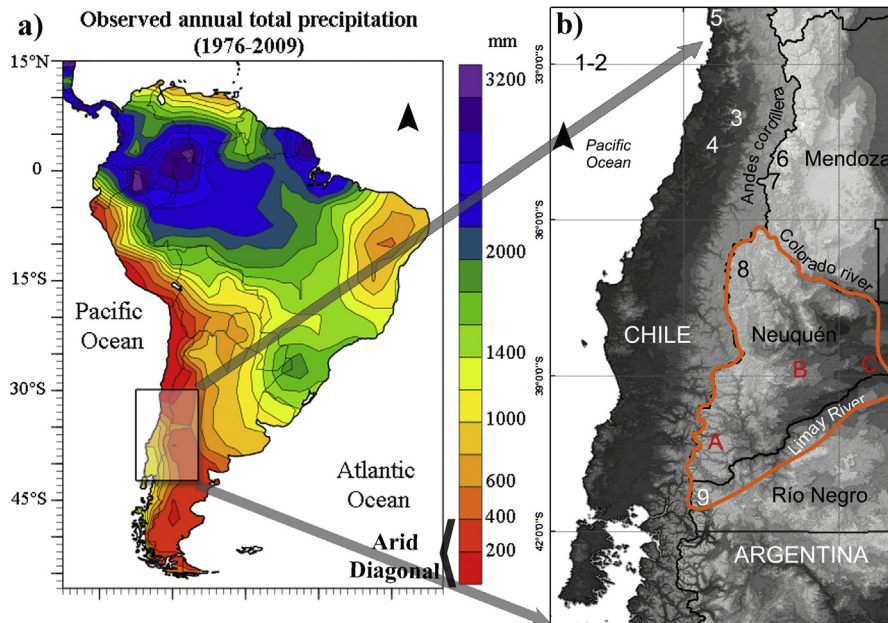
Northwestern Patagonia is located on the east side of the Andes and the adjacent volcanic fields and plateaus between 35° and 41°S (Fig. 1). Climate regime is characterized by winter precipitation and summer droughts, although seasonality disappears to the east (San Martín de Los Andes vs. Neuquén climograms; Fig. 2). During the

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**Fig. 1.** a) South America: observed total annual precipitation between 1976 and 2009 (source: Liebmann and Allured, 2005). b) Location of study area (orange outline); climograms location (A) San Martín de Los Andes, (B) Zapala, (C) Neuquén City; and palaeorecords mentioned in the text (1–10; see Table 1).

austral winter, the Southern Westerly Wind Belt (westerlies, herein) migrates northwards affecting regions up to about 30°S (Garreaud et al., 2008). Precipitation occurs through frontal systems associated with migratory surface cyclones that tend to migrate eastward along rather narrow latitudinal bands known as “storm tracks” (Garreaud et al., 2008). As a consequence of the rain shadow effect produced by the forced subsidence of the surface winds over the Andes, precipitations present a strong west-east decreasing gradient. Thus, annual precipitation varies from 1065 mm close to the Chile–Argentina border (San Martín de los Andes; Fig. 2a), to 205 mm in Zapala (Fig. 2b) and 172 mm (Neuquén; Fig. 2c) in the Patagonia plateau to the east.

Vegetation distribution follows the decreasing west-east precipitation gradient, from the forest to the grass steppe and then to shrub steppe communities. Forest [Subantarctic province (Roig, 1998)] distribution is almost confined to the Andean slopes and former glacial valleys. Forest communities in Neuquén and northern Río Negro provinces are diverse including the *Araucaria araucana* forest, the *Nothofagus* sp. forest and the *Austrocedrus* forest (Roig, 1998). *A. araucana* usually associates with *Nothofagus dombeyi* and *Nothofagus pumilio* forming mixed forests whereas pure *Nothofagus obliqua*, *Nothofagus alpina* and *Nothofagus antarctica* forest develop in the area.

The *Festuca pallescens* grass steppe [Subantarctic province (Roig, 1998)] is a narrow and discontinuous band between 71° and 71°30'W. It is characterized by a high cover of grasses (>60%) accompanied by few shrubs, except for deteriorated areas where shrubs become abundant (Roig, 1998).

The shrub steppe comprises plant communities belonging to the Patagonic and Monte provinces (Payenia, Monte–Patagonia transition and Monte) as well as the transitional vegetation between them (Roig, 1998). The most frequent community distributed on volcanic landscapes from northern Neuquén (Payenia district, Patagonic province) is the shrub steppe dominated by *Ephedra ochreatea* together to *Lycium chilense*, *Senecio filaginoides*, *Grindelia chiloensis* and *Mulinum spinosum*, among others (León et al., 1998). The shrub-grass steppe (Occidental district, Patagonic province) is a

transitional community between the grass and the shrub steppes. It is a 60–80 cm tall plant community dominated by *Stipa speciosa*, *Stipa humilis*, *Adesmia campestris*, *Berberis heterophylla* and *Poa lanuginosa* (León et al., 1998).

### 3. Materials and methods

The  $^{14}\text{C}$  dates included in this paper were obtained through exhaustive review of published information, supplemented by a few unpublished dates, from northwestern Patagonian archaeological sites. The radiocarbon evidence is organized according to the three main plant communities described in Section 2. The chronological database presented here integrates the results produced by different research teams since the beginning of investigations in northwestern Patagonia. The results are spatially heterogeneous, with some regions largely devoid of systematic research. As defined here, this spatial unit includes Neuquén province, bounded by the Colorado river to the north and the Limay river to the south, plus the southern margin of the Limay river in Río Negro province (Fig. 1). The database is organized with single radiocarbon dates as the basic unit of analysis. The ages were obtained from diverse materials (charcoal, faunal and human bone, macro-botanical remains) related to human activity. It is not our goal to address each site in detail, but to identify the main trends emerging from the analysis.

The calibration of  $^{14}\text{C}$  ages and the multi sample Probability Plots were done using Calib Rev. 7.0.1 (Reimer et al., 2013). Ages are expressed at two-sigma confidence level and in calendar years BP. As radiocarbon ages of contemporaneous samples from the opposite hemispheres are different (McCormac et al., 2004; Hogg et al., 2011), we used the southern hemisphere calibration curve (SHCal13, Hogg et al., 2013).

### 4. Results

The results synthesized in this review are presented in two main sections: paleoecological trends and archaeo-chronological data.

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