



The historical and archaeological evidence for Southern Cone human–environment interaction

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In PNAS, Nanavati et al. (1) study the available high-resolution pollen and microcharcoal columns for the last 1,000 y along a latitudinal transect in Patagonia. The result is a serious effort to understand the degree of alteration of landscapes by the human use of fire and the introduction of nonnative plants. It is well accepted that Native American land use altered landscapes since before the arrival of Europeans, but this paper adds an articulation with relevant historical and archaeological information. Even when this evidence is not perfect, the presentation of the main cultural processes after European contact is useful, since it is the time when human influences are evident and relatively easier to track. I will concentrate my comment on the historical and archaeological evidence used to discuss some of the patterns, as well as the chronological problems exhibited by archaeological information for the last 500 y.

It must be noted that, while the earliest human presence in South Patagonia altered the distribution of tool stones and affected the fauna, it produced no evident impact on the plants. Ephemeral occupations, followed by abandonment and reoccupation thousands of years later, inform about nomadic peoples with large annual ranges. The use of fire certainly was within their toolkits, as demonstrated by hearths found at most early sites, but their low-intensity occupations failed to produce detectable impact on the environment. Nanavati et al. (1) show that the human imprint on the landscapes is not always evident, and—more important—is not exclusively dependent on population size. What population increase does is to augment the number of localities where pertinent information can be searched. In that sense, more interesting than the wider range of taxa exploited by foragers during the Late Holocene is the wider range of habitats that they occupied. This is true even though retreat from the high elevations was recorded near El Sosneado during the Late Holocene and there was a sharp demographic decrease that started during the 18th century CE—particularly in North Patagonia—as a result of the European contact. The point is that human dispersal and the existence of webs of contact through which foragers were connected along different habitats, ranging from the oceanic coasts to the Andean high mountains, are probably the main cause of the swift dispersal of nonnative plants, and this is a result that does not require full settlement, but simply circulation of people.

Horses as Agents of Change

The comparison of the pollen and microcharcoal information from Laguna El Sosneado, Mendoza, with other high-resolution records from southern South America is very

informative (1). Particularly, the good use of the abundant archaeological information from Mendoza highlights the important fact that humans appear as agents of modification of fire regimes, particularly since the 16th century CE. The El Sosneado sequence shows that human land use appears as the predominant driver of ecosystem dynamics for the last 200 y, a result based on the good chronological control in Mendoza. The contrast between El Sosneado and the rest of the examined sequences is explored in detail. In general, this is a very difficult period to deal with using archaeological information (see below), but Nanavati et al. (1) identify the introduction of nonnative animals, mainly the horse, as an important agent of environmental change. The precise year of the introduction of horses is not well known, but they were seen in northern Patagonia at the beginning of the 17th century CE (2). The time of introduction in South Patagonia is debated, but the earliest observation of mounted people is in 1741 at Cabo Virgenes, in the eastern mouth of the Strait of Magellan (3). The little available archaeological evidence is in general agreement with this date, including the discovery, by Spanish sailors from the frigate *San Antonio*, of a complex multi-individual burial (one man and two women) in 1746 near San Julián Bay. Not only were horse prints recognized near the tomb, but five horses stuffed with grass were found buried with the human bodies (4). From this example, it is clear that the introduction of the horse produced a significant impact on the behavior and organization of human groups (2, 5). The horse permitted the transport of huts made with up to 40 to 50 guanaco skins (6), which were impossible to move on foot, and made possible long-distance caravans that crossed Patagonia (6, 7). Semisedentary aggregations of several hundred individuals using about 50 huts were reported for those times (3, 8). In the end, the horse was associated with a truly new mode of land use, one that increased its potential for environmental disturbance. Not only were horses making use of the best pastures along the tracks, but they were also acting

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as dispersal agents of seeds. The abundant ethnohistoric and ethnographic references to Native American groups using fire speak to its importance (3, 5, 6, 8, 9). Fire was used to hunt, prepare fresh pastures for horses, maintain open tracks, make smoke signals, etc. Swiss traveler Georges Claraz observed, during his 1865–1866 expedition through the steppes of Chubut accompanied by Native Americans, the regularity and intensity of field burning that they provoked (9). To what extent these intense burning activities were related to the necessities of the horses, as generally assumed, is not completely clear, but probably to a high degree.

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Spanish Settlers as Agents of Change

But this explanation, focused on horses, cannot apply to the spread of *Rumex acetosella* and other nonnative species of plants, as well as increases in fire activity recorded at Río Rubens in ~1590–1640 CE (360–310 cal y BP) mentioned by Nanavati et al. (1). This evidence precedes the known dispersal of horses to South Patagonia by centuries, and the importance of this record has not yet been completely explored. Castaways from the earlier European wreckages in the 16th century could have impacted the local flora, but we do not know much about them. But, in 1584, more than 300 hundred Spanish people—basically farmers—settled the coasts of the Strait at two places, Rey Don Felipe and Nombre de Jesús (10, 11), located ~250 and 150 km from the Río Rubens bog. A farming strategy was not viable in that zone, and, in about 2 y, most of the colonists were dead, and one of the settlements—Rey Don Felipe—is now known as *Puerto Hambre* [Port Famine] as a result. What is notable is the contrast between the high ecological impact, as measured by the Río Rubens record, and the short duration of the Spanish settlements, since Nombre de Jesús was occupied for 9 mo, and Rey Don Felipe was occupied for little more than 2 y. Indeed, contamination with nonnative plants from either the castaways or the settlers occurred, particularly considering that the Spanish colonists were transporting all kinds of European plants to fulfill their failed goal to settle South Patagonia. Interestingly, *Rumex* was recovered at short palynological sequences in Cabo Virgenes itself, where Nombre de Jesús was founded. Pollen data from the upper section of a soil profile, buried by recent eolian deposits, present the highest *Rumex* values and were related to the impact produced by the introduction of sheep at the end of the 19th century CE, although the chronology of these events is still open to alternatives (12). Several expeditions on foot between the two Spanish settlements led to the quick abandonment of the Cabo Virgenes enclave, and probably help to explain this rapid nonnative plants

dispersal. Importantly, the general western movement of the colonizers was toward places closer to Río Rubens. Anyway, we must consider the possibility that this might be another example of indirect contact, where changes occurred before the arrival of Europeans to the bog area, as occurred with the spread of European diseases (13).

Precision Problems of the Archaeological Record

But only rarely do the archaeological records offer the precision found in our discussion of the 1584 settlement of the Strait of Magellan. Usually, the precision of environmental records of change during the last 500 y is not accompanied by a corresponding precision of the archaeological record. This problem was observed when archaeologists attempted detailed analyses of frequencies of tools through historical times (14, 15). The results of these studies are intriguing but basically show the low archaeological resolution for the last few hundred years. Indeed,

there are problems in assigning precise chronologies to particular archaeological finds (16), problems that are amplified by the lack of formational studies at most sites. Vertical migration or the accumulation of tools on stable surfaces—like paleosoils formed during the Little Ice Age—are important processes that need to be considered before the archaeological record can be confidently used. The historical period certainly presents an increase in the diversity of material evidence, as observed by Nanavati et al. (1), but this is not the result of an increase in the number of sites. Several factors, including limited interest in the historical period, selective destruction of the upper occupation of sites, and incapacity to recognize the upper layers as archaeologically significant, conspired against a more comprehensive picture of historical times. This lack of precision is important, because periods of 200 y to 500 y are sufficient for critical tool changes and replacement to occur (17), as confirmed by the few systematic studies of native sites from the historic period (18, 19).

Despite the mentioned problems, any effort to connect archaeology, ethnohistory, and ethnography with paleoenvironmental markers should be lauded. Even when the analysis of pollen, phytolith, and microparticles and macroparticles of charcoal provides the best possible evidence of environmental disturbance, there is a future role for archaeology in tracking changes in the recent interactions of humans with animals, plants, and landscapes, including measurements of disturbance. This said, it must be stated that the clever combination of historical and archaeological information used by Nanavati et al. (1) is sufficient to sustain two important conclusions: first, that the recorded patterns support the notion that alteration of ignition frequency muted the effects of climate on fire regimes and, second, that population size is not the main driver of change. Regardless, this should not distract us from the necessity to improve the ways we archaeologists tackle recent times.

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