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Guest Editorial

Ranked habitats and the process of human colonization of South America

The papers in this volume cover issues related with the human colonization of South America. They derive from the Symposium held at the XVIII INQUA Congress, in Bern, on 21–27 July 2011 entitled “Multidisciplinary Research on the Late Quaternary of South America: Humans, Animals, and Paleoenvironments” which aimed to integrate recently accumulated information concerning the availability of space and animals for the first human explorers of South America. It is true that the breadth of studies on multidisciplinary collaboration is great, but very few are applied to the human colonization of South America. INQUA offered the perfect framework for a Symposium on multidisciplinary studies with the capacity to cover this issue. Fifteen papers were presented and, of them, updated versions of several appear in this volume. Other papers along the same lines were also added.

One of the reasons that led us to organize this symposium was that most of the evidence previously used to construct archaeological models of the peopling process was derived from caves, with limited use of information obtained at other places. Caves are useful and not completely tapped sources of relevant information. For example, caves are rarely used as sources for non-archaeological data. Cave sites can be important faunal and climatic archives whose interpretation is relevant in varied ways for archaeological modeling. The recent recovery of climatic information in speleothems in the perihumid southern archipelagic Andes, at 53°S (Schimp et al., 2011) constitutes a good example of the quality of the available information. Other sources include paleontological evidence recovered from different classes of open-air or underwater loci (Santoro and Latorre, 2009; Cartajena et al., 2011). Palaeoclimatic and palaeoecological evidence obtained from lake cores, peatlands, and other repositories is important for modeling the process of human selection of habitats. Many of these sources are explored in this volume. As a result, we believe that a more integrated multidisciplinary panorama will be available about the diversity of habitats during the Late Pleistocene and Early Holocene. This should be helpful in establishing some of the conditions under which the human explorations in South America took place.

Early explorers of South America probably had a ranking of potentially attractive habitats. Grasslands are long established as top ranked habitats during the initial human exploration of the continent (Lynch, 1983), and it is possible that oceanic coasts rank high as well (Dixon, 2001; Erlandson, 2001). According to the available archaeological record, other habitats such as hinterland deserts or forests appear to have a lower status (Borrero, 2005). The availability and extension of past grasslands is a relatively well discussed subject (i.e. Sauer, 1944). However, this is not the case for other habitats (Clapperton, 1993). Recent research in Atacama focused on rodent middens and paleowetlands have suggested increased availability of water during the Late Pleistocene, making it a more attractive habitat for early human populations (Santoro et al., 2011). Other habitats were the subject of important changes as well, which is one reason to integrate paleoclimatic and paleoecological data into archaeological modeling. Indeed, the opportunities and constraints offered by the different habitats constitute essential information for modeling peopling processes (Beaton, 1991; Anderson and Gillam, 2001). For example, a discussion of Holocene coastal dynamics is integral to an understanding of Late Pleistocene human settlement. The reason is the combined action of changes in sea-level, tectonics and other factors that affect not only the visibility or preservation of archaeological sites, as is well known in places like British Columbia (Fedje and Mathewes, 2005), but also the potential for human installation at different times (Gusick and Faught, 2011; Watts et al., 2011). In many senses this is the basis for what can be called a taphonomic approach to the archaeology of peopling, and in many ways it is no different from what we also need to know for terrestrial environments.

The paper by Ritter et al. deals with the taphonomy of shell beds from the Tramandaí Lagoon, Brazil. They studied taphonomic variables for 1000 shells from two outcrops of *Erodona mactroides*, dated between 1580 ± 30 and 1870 ± 30 ^{14}C BP. In the first place, they offer a good descriptive protocol of taphonomic markers for mollusks. Secondly, the taphonomically active zone, the zone where shells are more likely to be destroyed, is widespread enough to expect that the shells from the two outcrops “will most likely leave no geological record.” The importance of dissolution as a leading taphonomic agent in lagoonal environments is highlighted, as well as the fact that the destructive processes in the lagoonal environment are more similar to those characterizing fluvial rather than marine environments. One is reminded of the classic observations of destruction of shells made by Charles Darwin on the Pacific coasts of South America (Darwin, 1846: 52). There are important lessons to be learned about dynamics here, particularly since archaeological sites were many times located at similar environments (Gaspar, 2000).

Some places and times are relatively more stable than others. The paper by Angulo et al. focuses on sea-level markers in the Fernando de Noronha Archipelago, Brazil. A variety of markers for paleo sea-levels was used and the result is that in these oceanic islands the Mid- to Late Holocene sea level was similar to present. The study gives support for the notion that the sand dunes were transgressive and formed during the postglacial sea-level rise prior

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to a Mid-Holocene maximum. As for most of the oceanic islands (i.e. Bjerck, 2000), those islands were discovered in the 16th century or later, and no evidence of previous human installation was ever found. However, starting with the crucial variable “distance from the continent”, in this case ~350 km, this fact does not diminish the necessity of knowing its environmental history. It can be safely said that these islands, probably unknown in prehistoric times, were outside of the ranking. It will be indeed interesting to know how to rank the southern ice-edge margin of the Arctic postulated as a route for potential Late Pleistocene explorers sailing from Europe as those postulated by the Solutrean Connection hypothesis (Stanford and Bradley, 2012).

The paper by Spiske et al. documents four historical tsunamis in the coasts of Peru and summarizes evidences for historically recorded tsunamis starting at least in 1562. The difficulties of dating tsunamis are well presented and the authors are impressed by the small number of detected layers resulting from tsunamis in Peru. Among other explanations for this absence, they consider their low visibility and preservation potential. Together with the information presented by Ritter et al. for shell beds, this analysis highlights what little of the coastal record is available for study. It is particularly impressive to learn that none of the sediments deposited was left eleven years after the Chimbote Tsunami of 1996. This information emphasizes our need to do the most with the small precious preserved parts of the past that we are able to recover. Palimpsests are not the worst enemies of archaeologists and other specialists in Quaternary history, they are the valuable preserved parts of the record. Knowledge about tsunami frequencies and intensity is important for risk management, and also for archaeological research. The magnitude of these coastal processes is enough to cover, transform and/or destroy extensive archaeological deposits. Since tsunamis and earthquakes are important sources affecting population history, as well as responsible for archaeological visibility and preservation, it is basic to have the most complete records of their occurrence in the past. Sandweiss and Quilter (2008) discuss three “classic” human responses to catastrophe, which are abandonment, adaptation and restoration. Importantly, all of them involve some kind of expected archaeological change or discontinuity. Clearly, these alternatives are related with the location of coasts exposed to tsunamis in the ranking of habitats. It certainly takes time for hunter-gatherers to accumulate pertinent knowledge for long-term planning of settlement, and *a priori* we cannot rule out that risks like tsunamis were important in making decisions.

When searching for sites in coastal settings, some of the evidence can be found under the water. The paper by Cartajena et al. presents evidence of a subaerially deposited bone assemblage in Site GNL Quintero 1, Central Chile, recovered at 13 m below sea level and 650 m offshore. This assemblage constitutes the first evidence “of a drowned terrestrial site on the continental West Coast of South America covered by sea-level rise after the Last Glacial Maximum”. The sedimentary matrix containing the bone assemblage was dated 13,640 ± 40 ^{14}C BP, which puts the surface accommodating the bones within the chronological target for the search of Late Pleistocene evidence of humans. The preservation of the material is good, and a high taxonomic diversity of extinct fauna was found. Carnivore punctures, and signs of abrasion, rodent gnawing and trampling were identified. This information is very relevant for the study of early coastal human occupation and migration along the Pacific coast (Dixon, 2001). The archaeological value of the deposits at Quintero 1 is not related with the particular evidence recovered at the site. Instead, its value resides in that it contributes evidence that can be used to construct a new search model for Late Pleistocene coastal sites. Detailed knowledge about the marine environment and its changes during the last 20,000 years or so is a requisite for future coastal archaeological endeavors (Fedje and Mathewes, 2005).

The presentation by Martin et al. contributes new evidence obtained at Cueva Chica, Ultima Esperanza. This region is world famous due to the fantastic preservation of Late Pleistocene organic tissues at Cueva del Milodón. Cueva Chica demonstrates that places which were very well known for locals and visitors for more than 100 years still offer significant new information. Beyond a long Late Pleistocene record of animal occupations, Cueva Chica offers the oldest known dates for Pleistocene fauna in the region, a result that impinges on the discussion of the paleogeography of the area (Stern et al., 2011). Also, the site is remarkable in that there is no evidence of human use during the Pleistocene. Even Holocene human use is restricted to the presence of two human bones. This is notable due to the relatively intense Late Pleistocene activity manifested at nearby Cueva del Medio (Nami, 1987) and the important Holocene archaeological signal recovered at Alero Pedro Cárdenas, located only some 80 m distant (Nami, 1989-1990). Paradoxically, as was also the case with oceanic islands, archaeologists have much to learn from continental places that were not used by humans.

The discussion about the Late Pleistocene faunal extinctions in South America is by definition multidisciplinary. This discussion is affected by the lack of basic chronological data (Barnosky and Lindsey, 2010). The paper by Prevosti and Schubert contributes the first radiocarbon date and results of stable isotopes (δ^{13}C and δ^{15}N) for the South American canid *Protocyon troglodytes*. The date of 17,338 ± 85 ^{14}C BP represents the youngest specimen dated. The stable isotopes indicate that *P. troglodytes* was a hypercarnivore, a fact in agreement with the results of morphological studies. It is suggested that *P. troglodytes* preyed on *Equus neogeus*, *Hippidion principale*, *Stegomastodon platensis*, *Toxodon*, and *Megatherium americanum*. This is the kind of information that will help us to model past ecosystems, allowing us to construct better models of the interaction between autochthonous animals and newly arrived humans.

A more detailed regionally oriented treatment of the interaction among carnivores and herbivores in Southern Patagonia is presented by Prevosti and Martin. In this case, the carnivore guild was represented by several extinct taxa such as *Smilodon*, *Panthera onca mesembrina*, *Arctotherium* sp. and *Dusicyon avus*, but also by the extant *Puma concolor*. By using body size, prey size, diet habits, stable isotopic analyses and taphonomic information, Prevosti and Martin reconstruct the relationships within the predator guild and between these carnivores and herbivores, mainly *Mylodon darwini*, *Hippidion saldiasi*, and *Lama guanicoe*. Importantly, morphology suggests that the little-known short face bear (*Arctotherium*) was mainly an omnivore that may have scavenged and occasionally hunted medium-large mammals such as camelids and horses. Stable isotopes also indicate that *P. o. mesembrina* ate larger proportions of *Hippidion* and *Lama gracilis*. Ecomorphology, stable isotopes, and taphonomic evidence clearly indicates that *P. o. mensembrina* consumed *Mylodon*, *Hippidion* and camelids, and that this taxa constituted its prey. The previous work by Martin with the Hauthal collection from Cueva del Mylodon already showed that “The skulls and mandibles, attributed to *Mylodon darwini* … preserve marks which are similar to those produced today by jaguars hunting large prey “ (Martin, 2008: 350), possibly indicating that this huge cave was hunting grounds for panthers.

Avilla et al. also present new data about the extinction of mammals in South America during the Late Pleistocene. In this case they studied the extinction of one population of mastodonts in Southeast Brazil between *ca*. 60,000 and 55,000 BP. The bone assemblage is the product of a mass-death, and the transportation by a fluvial agent. In this case, dry climatic conditions can be considered the cause of this extinction.

Three Electron Spin Resonance (ESR) dates on *Stegomastodon waringi* and Toxodontinae teeth from Brazil are presented by Baffa et al., adding new taxa dates. The new dates give an age of 50 ± 10 ka for *Stegomastodon* and 43 ± 8 ka and 5 ± 2 ka for Toxodontinae. The last date is one of the youngest for Toxodontinae and corroborates the presence of the clade in the Early Holocene. On the other hand, Scanferla et al. studied a new assemblage of large mammals from the Late Pleistocene of the Pampean Region, Argentina. The assemblage is composed by equids (*Hippidion principale*), the saber-tooth cat *Smilodon populator* (at least one adult and one juvenile), a giant ground sloth (*Megatherium americanum*), and the glyptodont *Doedicurus clavicaudatus*. Four ^{14}C dates indicate that the age of these samples falls between ca. 12,000–13,500 BP, producing new taxa dates for *Hippidion principale*, *Smilodon populator* and *Doedicurus clavicaudatus*. This constitutes an important contribution, because there are very few dates for these taxa from the Pampean Region (see Barnosky and Lindsey, 2010). Based on taphonomic observations (e.g., presence of carnivore marks), and the physical association between these mammals, the authors suggest that the glyptodont, and probably the other herbivores, were consumed by *Smilodon populator*.

The history of human adaptation in South America is one of Holocene diversification following the spread of humans throughout most of the continent. In their contribution, Brook et al. argue that variations observed in the history of human occupation of south Patagonia closely resemble changes in past vegetation, with little archaeological evidence during the cold and dry Antarctic Cold Reversal and humans moving into the Deseado area during the subsequent Younger Dryas interval that they define as warmer and slightly wetter. They use spatial and temporal variations in the frequency of radiocarbon dates to build their case, which documents a sustained process of utilization of steppe habitats, certainly a variant of the open spaces which Lynch (1983) considered to be favoured by the first human colonizers.

The paper by Hadler et al. discusses the relationship between human occupation and paleoenvironments in Southern Brazil during the Holocene, on the basis of two archaeological sites located in northeast Rio Grande do Sul State, Sangão rockshelter and Garivaldino rockshelter. Both sites have dates from 9400 to 3730 ^{14}C BP. Importantly, small mammals not related to human predation are identified. They demonstrate that environmental changes were slow and gradual during the Holocene. Once more, zooarchaeological analysis indicates a pattern of adaptive stability that persists throughout the Holocene, characterized by generalist strategies of subsistence. This is a general pattern in the Andean and Amazonian Holocene for the North part of South America. In this case, exploitation was focused mainly on forest resources. Together with older cases from the Amazon basin (Roosevelt et al., 1996) and the mountain forests of Colombia (Gnecco, 2000) the evidence indicates a relatively fast interest and appropriation of the forested environments.

Pardiñas and Teta analyzed a rich sample of micromammals deposited in caves of northwestern Patagonia, which covers the whole Holocene. Compared with living assemblages, the authors observed that the communities of micromammals remained stable during most of the Holocene, and only detected an increase in the number of desert-adapted species since the middle Holocene, and an abrupt change during the last 100–150 years. The authors interpreted that the stability of the micromammal community could be explained by the existence of only small climate changes that did not modify the environment, and/or because these communities were resilient to environmental changes. The strong change observed during the last 100–150 years was linked to human impact. This study is a very good contribution to the study of environmental change in northern Patagonia, and adds a "proxy" that it is not always contemplated in the exploration of climatic changes in Patagonia.

Fortier and Rincón described a new species of *Caiman* for the Early-Middle Pleistocene of Venezuela. The new species was recovered from the "Tar pits" of El Breal de Orocual, placed in the eastern area of Venezuela, an area for which there are very few published fossil sites. This site contains a very rich bone assemblage, especially mammals, and gives the possibility to study the faunas of the Early-Middle Pleistocene, a time scarcely represented in the north part of South America (Rincón et al., 2009). The mammalian fauna of this site showed a particular association that it is not represented in sites of the southern part of the continent (Rincón et al., 2009, 2011) and, in the case of the reptiles, the presence of extinct species not recorded in southern sites.

A final comment is that most of the papers indicate that taphonomy is a common research strategy, with examples of application ranging from underwater places to caves. Taphonomy serves many functions, from identifying background faunas, as in the paper by Hadler et al., to providing crucial information concerning the interaction between carnivores and herbivores as in the papers by Cartajena et al., Martin et al., and Prevosti and Martin. The chronology of little known carnivores, such as that presented by Prevosti and Schubert, contributes to future taphonomic assessments of Late Pleistocene bone assemblages. In other ways, this is also the case for other evaluations of the chronologies of faunal extinctions such as those presented by Avilla et al., Scanferla et al., or Baffa et al. The degree to which the fossil record might be incomplete is also explored by Ritter et al. and Spiske et al. Knowledge about conditions relatively stable through time, such as those presented by Angulo et al., Pardiñas and Teta or Brook et al. help produce taphonomic expectations for different classes of materials. Finally, the paper by Fortier and Rincón offers information from a tar pit, which is a particularly attractive preservation milieu.

In the end, the chronology of human utilization of habitats varies substantially, with the earliest occupations recorded at open habitats, clearly indicating probable sequences of human exploration and colonization of the continent. It is going to be interesting to know to what point this sequence of occupation is correlated with the processes of faunal extinctions and habitat deterioration. The main point is that only by getting a substantial knowledge about the environment before the arrival of humans, the potential habitats and its characterization we will be in a position to appreciate the intricacies of the human colonization of the continent.

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