Abstract. Our ethnoarchaeological research projects since 1986 were focused on testing and developing archaeological theory, inference systems, and methodologies for recovery and analysis in European hunter-gatherer archaeology. The research began contrasting the ethnographic image of the Tierra del Fuego gatherer-fisher-hunter groups with the archaeological record from sites attributable to the people defined as “Yamana” and “Selknam” by the ethnography. The research dealt with the variability of the management strategies of resources and space, linked to the social organization. We excavated settlements as well as burial and ritual places. We conclude with the necessity of using analytical categories of social significance related to work processes, the absolute value and the distribution and consumption of goods. Working with such categories allows a step forward but imposes the need to rethink some of the general analogies and common *a priori* in the study of prehistoric societies.
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Ethnoarchaeology as experiment

In 1975 we began with the archaeological investigation of Paleolithic and Mesolithic hunter-gatherer societies in Catalonia (Iberian Peninsula). During these investigations we realized the insufficiency of our methodologies to derive relevant conclusions. The prevalent culture-history approach in European continental archaeology was clearly obsolete, but the cultural materialism and neo-functionalist paradigms of the processual New Archaeology, which inferred social organization from adaptation to the paleoenvironment, seemed too mechanical and insufficient to us (Estevez and Vila 2006c).

From our perspective of historical materialism, the social organization of the societies (the relationships between people necessary to produce the requisites of survival and to reproduce the society) is historically determined and these dominant relationships characterize every society and can enter into a contradiction with their own system of subsistence strategies. Consequently, it is not possible to infer social organization from the systems of subsistence-strategies and it is also not possible to extrapolate it from ethnographic analogies of sub-actual (recently disappeared) societies, which contained their own long history. In order to overcome the actualism and uniformitarian extrapolations of pure environmental determinism, an archaeological approximation to these social relationships was needed. This would be independent from the reconstruction of the past environment and from the techniques of subsistence (for which good methodological advances were available at that time) (Estévez and Vila 1999).

Our aim was to verify the hypothesis that archaeology can produce a record relevant to the social relations in prehistoric hunter-gatherer societies. First, we started from the thesis/idea that the spatial organization (macro, semi-micro, and micro) of production and consumption activities was a metaphoric expression of those relations, such that the analysis of the spatial relations of the archaeological record would provide the critical information
(Estévez et al. 1984). The problem consisted of establishing the significant operative categories of those social relations because the categories that were traditionally used in hunter-gatherer archaeology were no longer suitable (Vila and Argelés 1986).

We thought we should experiment and find new conceptual instruments starting from an ethnoarchaeological example. So we consider our twenty years of ethnoarchaeological research as just an experiment. The objective of the experiment is the search for archaeological indicators of social relations among prehistoric hunter-gatherers. One of the features we were most interested in was the possibility to establish archaeologically the state of inequality between women and men since we considered that was the key to the development of the societies ruled by the contradiction between production and reproduction (Estévez et al. 1998).

The experiment should be started with a study of the historical and ethnographic record to ascertain the essential features of the society, and should be continued with the excavation and analysis of the archaeological evidence of the same society from ethnographic times. The aim of the archaeological research is to analyze and evaluate the variables we use, and to test and to develop the systems that would allow obtaining the foreseen results. That is, to identify the essential features of the society that we previously had documented through the ethnographic information. In other words, given previous knowledge of the output (social relations in ethnography), how are the inputs (archaeological data) to be organized and the “black box” to be calibrated to derive the same output (archaeological social relations? Actually we want to test if or how archaeology would be capable of obtaining the same information on the essential elements of the studied ethnographic society (Piana et al. 1992, Vila and Estévez 2001).

**Conditions of the experiment**
In order to carry out this experiment some requirements had to be fulfilled: we needed a well-known (ethnographically and historically) society, able to be studied with archaeological methods. Direct ethnographic observation was not necessary if the required information was already registered. It was more important to analyze information on a hunter-gatherer society under little influence from industrial society, but with some information about its history. That is why in 1986 we decided to take advantage of the opportunity to carry out a Spanish-Argentine project in Tierra del Fuego. According to the conditions that we established, Tierra del Fuego was an optimal laboratory.

First, there was good ethnographic information from a long period of time because the people of Tierra del Fuego were always relevant for hunter-gatherer explanatory paradigms (Piana, 1984). The first information, dated from 1624, is the description of the Nassau Fleet by Hermite (1829). Additional accounts are available from the scientific voyages of the Beagle and the Adventure, the 1836 account of Darwin, the 1882 detailed descriptions of the “Mission Scientifique Du Cap Horn” that also included some aspects of the population biology, and the comprehensive ethnographic information from 1912-1935 by the ethnographer Pater Gusinde (for an extensive compilation of references see Orquera and Piana 1999a).

To complement the ethnographic information we had a large body of previous archaeological work by our Argentinean colleagues on the older settlements of the northern Beagle Channel coast. This work provided a very complete sequence from the first settlement, around 6900 BP (Tunel I site), through 4200 BP on the site Lancha Packewaia, and until 500 BP at Shamakush (Orquera and Piana 1999b, Piana and Orquera, this volume). The excellent preservation and high visibility of the archaeological sites - mainly consisting of shell-middens - provided us with the possibility of selecting for excavating sites of the same society described in ethnographic contact times.
As well as fulfilling these ethnographic and archaeological requirements, there were some other advantages. Tierra del Fuego became an island around 9000 BP, shortly after the first human settlement. It is a large island of more than 21,390 km² and the largest island of the southernmost part of America where, according to the ethnographer Gusinde (Gusinde 1937), at least three ethnic groups coexisted. The insular and isolated characteristics of this area are good conditions for an experimental approach. The study of islands increases the experimental resolution power of archaeology as social science because the study of societies in island environments is a good means of controlling some variables in the analysis of social behavior. Another advantage is the limited change in the environment resulting from the low density of occupation by European settlers at the time we started working in the region. This situation facilitated the reconstruction of the ancient resource potential. (Estévez, Vila, and Terradas 2002). Although we planned just a short term research at the beginning, the first project was continued alongside other successive projects on which we are still working because of the complexity of the subject and the richness of relevant data obtained during the first years.

**Historical and Ethnographic Sources: Determining the Essential Features of the Society**

The project began with a critical analysis of all the existing ethnographic written and graphic sources. At the same time we studied the main Fuegian ethnographic collections in Europe using archaeological analysis techniques. The purpose of this analysis was to establish correspondences between the results of the archaeological analysis of the items and their meanings concerning production (from the acquisition of the raw material until the final assembly of the item), and use.

In doing so we could evaluate the potential of inferring the presence of those items in a possible archaeological site. In other words, we would determine the possibility of obtaining
a complete view of the items produced by these societies using the standard archaeological methodology. The study showed that the diverse ethnographic sources and the samples of material culture found in the museums were biased by the social and scientific context of the people involved in the collecting. For example, in the *Musee de L'Homme* of Paris an emphasis on technology could be noticed, in the *Museum of Mankind* (British Museum) the emphasis was on households and technology (tools and utensils), in the Museums of St. Petersburg and Berlin on weapon and technology, while in the *Museum für Völkerkunde* of Vienna and in the *Vatican Museum* the most significant subject was ideology, a consequence of collection by missionaries (Estévez and Vila 2006 b).

Having different sources, sometimes even contradictory, was an interesting contrasting element, but only with a critical synthesis of every source could we get a more objective image. That brought us to test computer-assisted modelling. With the program “KIPA”, implemented in a neural network shell called MacBrain© by Neurix Inc., we wanted to analyze in the most objective way, by means of a localised neural network, the social position of women in hunter-gatherer societies (Barceló, Vila and Argelés 1994). The units in the model represented agents, actions and beneficiaries. The agents were designed as old male, old female, young male, young female, male children and female children. We simulated how the social preeminence of men over women depended on the number of productive and reproductive actions they do and the benefits they receive from the actions done by others. The activation of the network spreads from the people units (agents) to the action units (all the activities done by each type of agent), and back to the people units (feedback). The modeling results were very interesting because they showed a strong social asymmetry in which women’s role was clearly inferior to men’s role (Vila and Ruiz 2001). We are continuing work in this direction.

We also developed a system to evaluate the real value of the produced items and the
social reproduction activities. Real value is an absolute measurement of the relative effort invested in the production of consumed goods, thus making possible the valuation of the efforts invested in production by every social segment (adult men, adult women, and children) and of the benefit that each segment recovers from this effort through consumption (Barceló, et al.2006). We then adapted this conceptual instrument to the analysis of the archaeologically studied settlements. We calculated the effort involved in each consumed product through the ethnographic information, the experimentation and replication of the productive activities, the knowledge of the physical and chemical processes involved, and the analysis of the produced modifications (macro- and microscopic as well as chemical modifications). We did this by decomposing each process into their successive steps and adding values in terms of brief labor, half a day, full day, and more than a day tasks, and work done by one person, two people, or various people. We then made an inventory of the items produced (including the labor effort involved producing non-material items related to living conditions, e.g., cleaning, firing for heating and lighting, for every occupation moment. Lastly, we calculated the expended labor force by the different social segments of the group (male, female, old, young, children) taking into account the ethnographic data and experimenting with other models and combinations.

Currently we are linking the model with multiagent systems experiments in order to follow the process of the emergence and selection of norms (the emergence of inequality) in real and simulated (artificially controlled) hunter-gatherer societies.

Finally, the bioanthropological analysis of the recent and ancient population permitted verification of the presence of boundaries and the acquisition of an objective image of the biological and reproductive distances between Tierra del Fuego's native people (García-Moro, Hernández, and Turbón Daniel, 1988; Pérez Pérez, 1996).
The second phase of the project required the excavation of an archaeological site. The site selected (Túnel VII) was located near Túnel I (oldest dates around 6900 BP), at the time the oldest site investigated by our Argentinean colleagues. This site selection enabled comparison of the oldest site with a modern one (the latter occupied from the end of the seventeenth century to the end of the nineteenth century), and both were situated in the same biotope of the Beagle Channel and exhibited similar geographic features. Between 1988 and 1992, four excavation seasons were conducted at this site (Estévez and Vila 1996). The excavation system developed by our colleagues made possible an empirical identification of thin stratification subunits in the shell-middens (Orquera and Piana 1992), such that a very detailed and complex stratigraphic sequence with high resolution was obtained. A total of 272 stratigraphic subunits was isolated in Túnel VII in the lower segment (the oldest occupation phase of the site) over an area of 32 m². These subunits varied in volume from 160 liters to just 0.3 liters. The series of volumes does not match statistically with a normal (Gaussian) distribution. The surface of these subunits was also very variable, ranging from 0.02 square meters to more than 5 square meters (Estévez and Vila 2000). Together with our Argentinean colleagues we adapted the system so we could isolate and record one discrete spatial unit sufficient to satisfy the needs of our problem formulation, which was to establish the pertinence of spatial analysis through the definition of significant categories for the study of
the social organization.

The sequence of superimposed stratigraphic subunits, associated with the superposition of central fireplaces, drove us to the conclusion that the site exhibited different occupation periods during at least one hundred years from the end of the eighteenth century. We could register a repeated pattern in the use of space on the site (Wünsch 1992). The remnants of post holes, the wall effects detected, and the placement of the residues let us infer the repeated superposition of circular structures of 3.5 m in diameter with central fireplaces and some waste accumulation on the periphery, a pattern matching the descriptions of the huts of Yamana people (Fig.1).

Although there was a general tendency for resource exploitation to be consistent with the surrounding biotope (through the several occupation periods), a remarkable variability and some significant differences could be noticed (Estévez and Vila 2006a). This variability in resource exploitation did not necessarily reflect adjustment to the seasonal variability in resource availability (Estévez, et al., 2001).

During the archaeological work we perceived the need for a parallel experimental program. One of these experiments concerned the formation processes of the site. In order to understand the site it was essential to know the results of an occupation dynamic caused by the construction of a hut similar to those in Yamana ethnography, the recognizable characteristics of the fireplaces, the nature of residue distributions derived from the consumption of mollusks, trampling, etc. Taphonomic observations were necessary: which kinds of residues can be found under natural circumstances along beaches without human intervention, how is the soil created on shell-middens, what level of bioturbation is expectable, and which transformative factors can appear after the moment of deposition? The experimental program clarified aspects of site dynamics: for instance, the long durability of a hut’s framework allows its reuse, accounting for why they were not dismantled and for why
did Yamana people reoccupied the same space repeatedly.

In order to verify the hypothesis about the site formation processes, as well as to understand how the thin layers of stratigraphic subunits in the shell-middens could be isolated, micromorphological analyses were conducted on samples taken from different points on the site. We also took two macro-columns, long Kubiena boxes that included the entire stratigraphy at the main entrance of the huts. The analysis showed shells broken in small pieces and probably re-deposited (not *in situ*), shells broken *in situ* by pressure or trampling, whole shells, organic matter mixed up with broken and intact shells, etc. These distributions illustrate the causes of stratigraphic discontinuities by showing that this part of the deposit was formed by material coming from different areas as well as by different processes of deposition and postdepositional deformation: intact shell-midden, trampled shell-midden, frequently used areas, etc.

The archaeological samples were contrasted with different experimental samples, which were collected from places where formation variables could be controlled. We took samples from natural soils in the forest and in open spaces, from transited trails and experimental living floors, from fireplaces of a range of controlled duration and temperatures, on different type of soils, from natural and anthropogenic mussel accumulations, from different types of beaches, etc.

In order to examine and assess the working processes it was necessary to establish a program of experimental replications. That was particularly necessary for those processes that were poorly represented or ignored in the ethnographic record, but present as residues in the archaeological record. The most significant was the process of stone flaking and the manufacture of lithic bifacial projectile and dagger points (Briz et al. 2005, Clemente 1997). Although lithic points were widely represented in the museum collections the most reliable
ethnography attributed their manufacture to the northern groups.

The experimental approach described above, involving first heuristic experiments and then controlled analysis of specified variables, cannot be substituted by an ethnographic quest of a “living (ethno) archaeology”, which will always be complicated by intersubjectivity between the observer and the interviewed person, by temporal bias and particularly by the contemporary global world influence that has completely disturbed the traditional ways of life of the remnants of hunter-gatherer societies. Such ethnoarchaeological research will also have difficulties conducting the taphonomic and post-depositional observations that are relevant to archaeological interpretation.

The preliminary results led us to continue with our research, which required additional experimentation (Vila and Estévez 2000), and we also wanted to check the degree of environmental influence on variability in resource management and the occupation of space within the same social group. We began a new investigation on a site 57 km to the east of Tunel VII, although situated inside the Yamana geographic territory according to the ethnographic descriptions, but located in a different biotope with a different environment and availability of resources. In this case the site is not located on the foot of a mountain range but on a low and slightly hilly landscape. A penguin nesting-colony is situated today very close on a nearby island. Guanaco herds come down from the mountains to this area during the winters. We completed the taphonomic experiments on site formation and replicative experiments on tool production processes (Estevez and Mameli 2000) as well as conducting intensive surveying, sampling, and dating of sites along the Beagle Channel in order to establish a paleoenvironmental baseline. The paleoenvironmental studies, which are important from an environmental point of view and for our Argentinean colleagues, were aimed at relating the observable changes in the resources consumed by the hunter-gatherer population with the oscillations of the environmental abiotic conditions established from
isotopic studies of molluscs (Obelic et al. 1999). Variability of settlements and resource management was assessed from the marine resource system as represented in the archaeozoological record and compared with ethnographic data and the contemporary situation. The last objective was to evaluate the biases and modifications present and to verify the possible impact of global changes on these conditions. The oldest oscillations and parameters during pre-industrial times were compared with the current ones (Vila et al., 1997).

During the years 1995 and 1996 we excavated the Lanashuaia site (like Túnel VII dated to the European Contact period) and analyzed the last occupation layer (the top layer) of the Alashawaia site. At Lanashuaia we noticed a quantitatively different capture of the fauna, botanical, and mineral resources in comparison to the Túnel VII site. Although in the Lanashuaia site there was just one demonstrated occupation episode, the pattern of the organization of the inhabited space was the same as in Túnel VII (Piana, Estévez, and Vila 2000).

An important part of our work was based on experimenting with the sampling systems. Sampling was needed because of the great quantity of remains that resulted from an extensive excavation and from the nature of some of those remains. There are tens of thousands of mollusks, for example, because they constitute the main part of the sediments. Fish was also sampled because thousands of small-sized remains were found. Apart from these elements collected by statistical sampling, the 272 subunits of the site studied yielded 22,303 lithic remains (including residues –that is byproducts from production and use and rejected pieces –failed and unfinished tools) and more than 10,000 fragments of bone.

We questioned traditional sampling because we began with the hypothesis of a non-homogeneous distribution in space. The open-area excavation we proposed cannot be
accomplished with sampling systems designed for excavations with stratigraphic purposes and a main emphasis on diachrony. Traditional excavations have developed the usual column-sampling systems. Statistical analysis showed that these sample systems did not reflect the complex composition of the site, or provide a representative composition of the shell midden subunits. Instead we took all the sediments of some of the individual subunits and collected it in 0.5 liter bags. Then we implemented a statistical test of random samplings of the bags to establish the necessary volume for a representative sample of the whole composition of the subunit. This procedure allowed fixing a volume of 0.5 liters to get a satisfactory sample of the fish remains and a volume of 4 liters for the composition of shells and sediments. Therefore we took a sample of homogenized 4 liters sediment from each subunit to have a more accurate sampling of the whole site.

The sediments on our sites are mainly composed of consumption remains (shells) abandoned in a settlement. We started with the postulate that the human activities of production, distribution, consumption, and deposition are socially organized. From this proposition, we can follow with the corollary that this archaeological evidence (included in a mainly anthropogenic sedimentation) should reflect the social conditions if post-depositional factors did not disturb the order of the deposit in a way that cannot be retraced. Anyhow, the contrary (that is a meaningful distribution of the evidence) cannot be assumed a priori. It has to be proved that the differences on the horizontal distribution (of a representative sample of a discrete moment) are not relevant. The possibility of a random nature of the deposition has allways to be demonstrated in a way that cannot be attributed to a lack of an adequate taphonomic filtering system. If we assume from the beginning a random or non-structured distribution and if we use a consequent sampling technique, then we can hardly discover the hidden organization, nor can we demonstrate the actual performance of the sample we have taken. For instance, tacking just one column sample assuming a homogeneous distribution in
shell midden sites will never reveal the actual differences and the spatial structuration of the site. Likewise, just digging several test pits or counting samples from randomly chosen places will never reveal the continuities or limits in socially relevant distributions. Therefore, instead of assuming automatically an irrelevant (homogeneous or random) organization of the evidence we should develop systems to search for significant differences and try to explain them right from the beginning of the excavation.

In the Tierra del Fuego sites, we could relate garbage areas constituted mainly by middens of mussels with other areas that were cleaned. We built a system of sampling not based on columns and more adequate for extensive excavations. The statistical analysis of the horizontal distributions of every occupation period in the Túnel VII site proved that the remains are not uniformly distributed (Estevez and Vila 2007). For example, the faunal samples deposited in different spots over an occupation episode vary significantly from the center to the peripheries of the occupation surface, indicating a differential depositional strategy. That means there was a working effort (a labor invested) to arrange the used space – an organization (set of social rules) for the distribution of the places for working, consumption, and deposition of the generated residues (Clemente and Estevez, in press).

At a microscopic level a non-uniform distribution could be noticed, for example in the phytoliths, which have a clear anthropogenic origin. Their distribution can be correlated to the arrangement of space, such as the huge accumulation of fern (*Penna marina*) phytoliths on the northwestern part of the hut’s interior of Túnel VII, which can be related to sleeping spaces and/or to the hut’s covering in that place (Zurro et al. 2007).

The slowness of data recording in the field during the extensive excavations and the need to register the thin layers of deposition, forced us to develop automatic recording systems to accelerate the field work. In 1995 we used a total station to record the data directly into the field computer. But the rapid developments of the computing devices led us to try
new recording systems using the total topographical station, GIS and computer-aided methods (see Barceló and Maximiano this volume), and geo-referenced digital imagery to facilitate 3D recovery, evaluation, and representation of the stratigraphic subunits described.

These methods were tested during the excavations of 2001 and 2002 in the sites of Estancia Remolinos. In these sites we wanted to complete our record with the analysis of archaeological evidence related to the process of social reproduction: the first was the excavation of a funerary context also from ethnographic time (less than two centuries old dated by $^{14}$C) which was discovered by our colleague Ernesto Piana. It was located in the rock shelter Mischiwen III close to the ancient residence of an Anglican missionary. This record completed the information collected in 1995 during the rescue excavation of a burial in Haberton Harbour 35 kilometers to the east. These excavations made us realize that, in the case of the Yamana society, the special treatment that the deceased received from the living was more relevant than the specific form of the burial itself. The burial system could be like that represented in Mischiwen III: a lightly prepared place in a rockshelter, setting the dead in a contractive position with a light cover of stones and branches. It could also consist of a deep hole dug into a shellmound like in Haberton, or sinking the body in a bog like the remains we found near the site of Lanashuaia. The ethnographic sources also describe the burning of the dead together with their hut (Vila, Casas. and Vicente, 2006).

Secondly, we carried out the excavation of a site (Cabaña Remolino) specifically devoted to activities related to socialization, what is commonly called a ritual context (Vila and Ruiz 2001). There was also ethnographic and photographic information that permitted the identification of this site, one of the last ritual places in Estancia Remolinos. Although the site was partly disturbed by subsequent European activity, it was still possible to rescue a section of the edge of a hut and a fireplace. After the Cabaña Remolino work, a question arises: the difficulty of identifying a site like this, which apart from containing larger than
usual huts, did not provide us with any extraordinary distinctive archaeological material that could unequivocally be attributed to the special activity of social reproduction that took place in the site (Vila 2004).

In order to complete our work, to cope with the variability, and to look for archaeologically significant differences between the ethnic groups established by the ethnography, we decided to go “beyond the frontier”. We wanted to consider if there is some distinction between the Yamana and Selknam groups described by the ethnographers that can be traced through the archaeological record. Most of the archaeology of prehistoric hunter-gatherers in continental western Europe has centered its research on attributing the differences in the retouched and formalized bone and antler items to ethnic differences (Estévez and Vila 2006). Therefore, it is a relevant question to evaluate if these attributes can be applied to this ethnographically controlled case. We also wanted to confirm our preliminary conclusions about the difficulty of identification of the socialization spaces with respect to daily life settlements, which arose from our excavations in Cabaña Remolinos. Beginning in 2002 we carried out excavations of Selknam ritual and settlement places in Ewan, near the northern coast of Tierra del Fuego, 110 km north of the first site Túnel VII. This constitutes a new line of investigation (see Mansur and Pique in this volume, Vila, Piqué, and Mansur 2004).

The research carried out by our team also continues in the Beagle Channel area, in Lanashuaia, in order to evaluate the possibility of establishing relations between different synchronic units of occupation (households). There, we detected the exploitation of a stranded whale that was surely shared by more than one social unit at the time of occupation of the Lanashuaia site. The evidence of multiple hut traces on the beach next to the structure excavated in 1995 brings us to the supposition that at least some of the huts could be contemporary with the one that we worked on. In the coming years we will try to locate and
excavate some of them in order to establish the connections between them.

**Discussion**

During the research program we realized the need to combine several analytical methods in order to achieve significant conclusions. The potential variability between stratigraphic subunits (in a vertical diachronic or horizontal synchronic sense) depends on the organization of activities of production, distribution, consumption, and deposition as well as on the inequality of consumption and on the recurrence, normalization, regulation, and fixing of habits of discarding residues and of the arrangement of space.

We think that it is possible to verify the recurrences and the variability in the strategies of subsistence, in the organization of space and in the distribution of real value or consumption value of the products of labor. For this purpose it is indispensable to confront technological procedures of production and consumption within the spatial context: the activity and discard areas have to be discriminated and connected. It is necessary to identify the processes of production and recycling of tools and the articulation of working activities. For example, the processes of flaking, resharpening, and recycling of tools (lithic residues) and other items have to be related, sequenced, and connected with the tasks of butchering, dismembering, cooking, and with the intra-site circulation and distribution of products (animal foodbone residues). Those products must be assessed in terms of their real and consumption values. Finally, we have to try to identify possible differential consumption of goods and food.

In order to achieve the purpose of analyzing the different strategies of resource
management, of production and consumption of tools or other produced goods, and of quantifying the relative social effort involved (that is to calculate the absolute value), it is necessary to plot the different types of residues as categorized by value. Examples of value categorization included: production residues of high value consumption goods, remains of high value finished consumed goods, low value amortized goods, low value consumed items, etc.). In that way we can picture the dynamics of work and the distribution of the consumed goods (Clemente and Estévez, in press). But the spatial distribution (locations and connections) and density analysis of consumed products have to operate with other categories than the direct descriptive analytical categories. They must be the result of a preceding work of combining use-wear, raw material, and technological analysis on lithic as well on bone residues, the analysis of faunal resource exploitation, consideration of the experimental replications, and the analysis of taphonomy. The spatial analysis has to be contrasted with soil micromorphology, the chemical analysis of soils and fats, and the analysis of phytoliths from synchronic samples of sediments collected from different strategic areas of the site.

One of the most interesting analytical components was the refitting. The record of the exact position of items and the 50 cm grid within which all the remains were collected allows the use of refitting both bones and lithics to help in the stratigraphic analysis. In fact, refitting was not only designed to fix stratigraphic links and to control post-depositional processes, but also to identify activity and discard areas, intra-site circulation of products and the articulation of working and consumption activities.

Conjoining and refitting lithic residues concern different types of matching: core to flake (in the core the flaking surface against the ventral faces of flakes), flake to flake (ventral and dorsal faces), and between the same flake (sagital or transversal fractures). The bone refittings were classified into different kinds and probabilities: Repairs (that is the re-assembling of ancient broken bones), re-articulations (very exact matching of bones of the
same articular surface), and hypotheses (sure, probable, and possible) about the reassembling of individual skeletons (taking into account the sex, age, size, morphology, and diagenesis).

In the 32 m$^2$ and 55 cm maximum depth of the site Tunel VII we have measured 10,500 items exactly and recovered the remaining items in a 50 by 50 cm grid, isolating the materials from each of the stratigraphic subunits. From a total of 10,476 faunal pieces we found 1,555 refits, 76 repairs for bird bones, 443 for sea lions, 2 for cetacean, and 13 for guanaco, and 44 parts of different sea lion skeletons could be rearticulated.

Despite the fast sedimentation rate of shell-midden sediments, we do not believe in an exact “Pompeii-like” process. A 25% proportion of the refits link different subunits, but the high quantity of such refits allows filtering the most significant ones in a qualitative and a statistical way. We have to consider the state of conservation of the bones and their surface modifications (trampling, polishing, rolling), as well as their position (on the bottom, middle or top) of the subunit and the way they are laying (horizontal, vertical, following the shell orientations, etc.), thereby evaluating the refits individually.

Some substantive conclusions for hunter-gatherer archaeology

Apart from this methodological and analytical system, the experience we developed in Tierra del Fuego brought substantive theoretical issues to mind and some general thoughts about hunter-fisher-gatherer societies: That ethnographic analogy is suitable only in the stage of suggesting hypotheses because the ethnographic record is biased (socially and historically) and subjective. The ethnographic records change over time, not just because of changing ethnographic paradigms, but also because hunter-gatherer societies were dynamic, flexible, and could change very quickly even prior to the ethnographic contact. So the question arises as to which kind of source, from when, and collected by whom, should be used in an
analogy?

Sometimes the archaeological record is more reliable and objective than the ethnographic sources. We could notice that the ethnography did not take into consideration some elements such as the stone knapping. The production of tanged points is especially relevant in all our sites, but arrow point production was denied in the ethnographic record; the archaeological data correct this record. Archaeology also demonstrates that these societies did not always follow the most economically profitable processes (an optimal technological adaptation to the environmental availability of natural resources).

The conjoint analysis of bones and stone tools demonstrates that some not preview and unspecialized hunting techniques (for instance, hunting sea lions with arrows instead of the more adequate hunting with harpoons) were usually employed on occasional close encounters between people and prey. Although the Yamana people can be characterized by a subsistence-system specialized on marine resources, switching from very specialized hunting techniques to opportunistic behavior was normal. There was a great flexibility in the means of production used; for example: harpoon points in the archaeological record that match with ethnographic descriptions are weapons perfectly adapted to the hunt of sea lions. But the archaeological record also indicates the use of arrows because some sea lion bones had embedded arrow point tips (Mameli, Estévez and Piana 2005).

Furthermore, the frequencies of all kind of remains- tools and consumed food - change along the sequence of occupations in Túnel VII (Estévez and Vila, 2007).

One of the main issues that we recognize is that, despite ethnographic information, Fuegian people did not constitute an egalitarian society. The sexual division of labor was the basis for political inequality and discrimination, caused by the need to control reproduction. Some critical working activities (such as collecting firewood) are less archaeologically
visible, but are more effort and time consuming than other activities that are more valued socially and are more archaeologically visible and discussed (Pique 1999).

It is not too difficult to calculate archaeologically the real values of labor (the time effort involved in the production of goods) considering the landscape, the tools and techniques available, and the products that result from labor. In our ethnographic case the existence of a rule-based division of labor among the hunter-gatherers of Tierra del Fuego is well documented. The analysis of this ethnographic information driven from our archaeological perspective and oriented towards reconstruction of the production processes allows the evaluation of the real value of the production made by women, men, and children. This calculation can be related to the consumption of the produced goods (for instance through statistical treatment using categorical principal components analysis). The relation between the scores of produced real value and of consumed real value by the different social categories can highlight the inequality, the discrimination, and undervaluation of women (Barceló et al. 2006). This is materialized in the different efforts invested by men and women in subsistence and reproduction. In our case we actually could state and calculate the inequality and the intensity of exploitation through the analysis of the varied ethnographic sources concerning the relation between these appropriated values and the generated values.

But this social relationship cannot be extrapolated simply from the subsistence economy. It cannot be transported to prehistoric archaeology from analogies with modern hunter-gatherers, even though they have similar technical production strategies, because the sexual distribution of tasks and the subjective valuation of products are social constructs based on ideological premises and not directly on ecological features.

First of all we should identify and appraise the working processes and their sets of rules. We could do this through the analysis of the normalization (verifying the existence
of specific patterns) and of the specialization of the spatial distribution. Then we could measure inequality (predominantly gender based) in prehistoric hunter-gatherer societies if we could identify archaeologically the sexual distribution of tasks. Therefore, what we need now is to develop archaeological methods (regardless of the androcentric record of the traditional ethnography) to analyze these men-women relationships. The importance of this investigation rests on the fact that these social relationships (basically the sexual division of labor) dominate the subsistence relationships (the hunting-gathering exploitation system), which are determinative (in the last instance). In fact, as our case demonstrates, the social system was less adaptative than the subsistence strategies.

This flexibility of the technology is demonstrated by the fast adaptation of the Fuegians to the new European raw materials (e.g., switching from stone to glass or from mussel knives to European-like metal knives) and techniques. On the other hand, the reproduction strategies failed because of diseases, population concentration and dispersal, which caused heavy population losses. Those losses were not compensated for by reorganization and liberation of the strategies of social reproduction.

There are signs of social adjustments along the sequence of human life in Tierra del Fuego in spite of the relative stability of the optimization systems of resource exploitation. In fact, we can admit that in hunter-gatherer societies adaptation was not simple, stable, and successful, but a dynamic attempt to maintain a social system in order to face the oscillations of resource availability and the natural tendency towards population growth. We suggest that hunter-gatherer societies are subject to tolerance levels against external changes, but this resilience is highly dependent on the time scale involved. The contact that the Fuegian societies had with Europeans caused a strong pressure and excessively abrupt changes, such that the continuation of their social organization was difficult. Social organization could not react fast enough to compensate for the population depletion caused
by European violence, illness, and the industrial exploitation of resources.

Another of the critical points in our ethnoarchaeological experience is whether we are sufficiently qualified in prehistoric archaeology to notice some elements of the social organization. We already mentioned our difficulties in the archaeological identification of specialized places of social and ideological reproduction if we were to extrapolate from the ethnographic cases. The Fuegian case is even more interesting because the described differences between the so-called terrestrial and maritime adaptations or between ethnic groups are neither always visible in artifacts or in the consumption goods; all the groups share most of them. Actually, a critical analysis of these ethnographic sources brings up the question of how meaningful these differences were.

They could be a product of preconceptions of the ethnographers and the sporadic collection of information. The ethnographic methodology samples information from few persons in very specific times and places (Vila 2000). The bias, which is very obvious in the case of the relations between men and women, could also be extended to the geographic variability and to the distinction of discrete frontiers between ethnic groups. Although at one moment three or four linguistic rules (languages) could be noticed, we might suggest that rather than ethnic barriers there was a complex map of clinal variation in the intensity of relations between people, who were very mobile, both in their geographical and social setting. But it is obvious that it is not always appropriate to speak about correlation between archaeological data sets and culture, whether considered as adaptation or as an ethnic category.
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Figure 1. a) Túnel VII excavation showing an occupation surface. The perimeter of the hut is demarcated by a line and the midden deposits and the central fireplace are shadowed. b) Graph with square meter grid of the lowest occupation phase showing the circular limits of the hut (the reconstructed hypothetical limits demarcated with dotted lines). The central fireplace (FP), the postholes (concentrical circles) and the refitting lines reflect perfectly the “wall effect”.

Figures