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RETHINKING ETHNOARCHEOLOGY: FOLLOWING A LONG TRAIL LOOKING TO IMPROVE HUNTER-FISHER-GATHERER SOCIAL ARCHAEOLOGY

ABSTRACT: Our paper describes the demarche of our research trail in Ethnoarchaeology over 20 years through various research projects since 1986, when we begun carrying out research projects in Tierra del Fuego (TdF). Our objective was to test and develop the archaeological methodology to open up the possibility of approaching the social organization of prehistoric hunter-fisher-gatherer (HFG) societies.

We follow chronologically and discuss the successive stages of our line of research and how one step led us to the next step, structuring a successive series of research projects. The bulky volume of bibliography produced including all the methodological details, empirical data, concrete results, etc... is cited at each step for readers who want to dig deeper into the details. There is also an open repository with all the documentation and information on the TdF projects.

The conclusion of this long lasting ethnoarchaeological experimental trail was that it is indeed possible, through Archeology, to determine the existence and functioning of social organization in prehistoric HFG.

Along these years following the same system of ethnoarchaeological contrasting, we analyzed the development of the coastal societies of the Northwest Coast of America with that of TdF, considered examples of the opposite extremes of HFG social organization. We stated the preponderance of social norms that regulate reproduction and their direct relationship with the discrimination of women and the division of labor according to sex. We have proposed as an explanation for this divergent development the alternative options for the management of reproduction.

To reinforce these conclusions, we replicate through the use of Agent Simulation the effect of specific social norms on the reproduction of five groups of HFG.

The conclusions reinforced that social norms that affect biological and social reproduction are critical for the sustainability of societies that do not directly control the reproduction of their resources.

KEY WORDS: Archaeology – Ethnoarchaeology – Theory – Social reproduction – Hunter-Fisher-Gatherer

AT THE BEGINNING

In order to explain our relationship with Ethnoarchaeology, we describe step by step the sequence of the theoretical, methodological, practical trajectory and conclusions that have directed and chained our work from 1986 to 2016 throughout 6 field research projects in cooperation with our Argentine colleagues and furthermore through 3 other successive international projects. All the reflections that have arisen and the results achieved throughout all these years have been extensively published (we give the references of them for each step as most are already in open access and can be easily consulted).

The insufficiency of the prior existing explanations. When we finished our university studies in the mid-1970s, Prehistoric Archeology in our country was, as a consequence of the interference in the academy of the Franco dictatorship, dominated by the chrono-cultural historical paradigm inherited from the German School and Abate Breuil. It was just beginning to open up to multidisciplinary studies from Quaternary Geology supported by the typologies of François Bordes and Denise de Sonneville (Estévez, Vila-Mitjà 2006a).

At a time of political and academic change, looking for alternatives from an approach within dialectical materialism, we participated in the discussions of the Analytical Typology Seminars organized by Professor Georges Laplace at the Centre de Palethnologie Stratigraphique in Arudy (France) and we promoted the annual Symposiums of Young Paleolithists in Spain. We could not ignore the experimental archaeology, the Taphonomy and the functional analysis developed by Soviet archeology, nor the Ethnoarchaeology that was developed by the North-American New Archeology from the Cultural Materialism and the approach of the English Analytical Archaeology. At the same time, we learned about the approaches of Latin American Social Archaeology, which incorporated a social analysis from the point of view of Marxism and the dialectic between social relations and the economic structure (Estévez, Vila-Mitjà 1999).

Our doctoral theses on the use of animal resources and on the work processes involved in the manufacture and use of lithic artifacts convinced us of the ineffectiveness of the adaptationist explanation of Cultural Materialism. The analysis of the faunal exploitation systems in the Paleo-Mesolithic sequence had shown us that the exploitation of this type of resource had come up against a series of unsustainable thresholds that had contributed to the end of the slower

reproducing species (Estévez 1979). The analysis of stone tools from the perspective of their manufacture and use had also convinced us that there were a series of economic irrationalities that pointed to conservative guidelines or norms of manufacture and use (Vila-Mitjà 1981). Thus, based on the need to explain this component of economic irrationality of the HFG societies of the Upper Paleolithic and Mesolithic, we argued that we could not satisfactorily explain the development of those societies by attributing it strictly to phenomena of climate change and adaptation processes. Taking Historical Materialism as a starting point, we find that the core of the explanation, the driving of change of these societies, was no longer their dialectic with changes in the environment, but rather in the internal contradiction between production and reproduction. In other words the main causes of change should be sought in the dialectic between the system of social organization and the system of exploitation of finite wild resources.

The "thesis of The Main Contradiction" – We argue that Paleo-Mesolithic societies were HFG that were not in a natural balance with the resources offered by the environment. Rather, they had to be constantly adjusting the exploitation of the limited resources, that their technology allowed access, through controlled social reproduction. We understood that the essential contradiction between production and reproduction dominated their historical trajectory. The social organization, in an unstable balance, was maintained by social norms through a division of labor based on sex and a social dissymmetry to the detriment of women that allowed control over reproduction. The possibility that our theory could be contrasted archaeologically was at that time considered outside the scope of the methodology of Archaeology. It was necessary to overcome the limitations of Paleolithic and Mesolithic archeology that had mainly insisted on typological and environmental issues (Estévez *et al.* 1998).

A POSSIBLE WAY OUT

Changing of the focus in analytics – We did not accept the arguments that there are no data in archeology to know the social organization and that it could only be supposed by extrapolating generalizations from what was had been observed in certain modern ethnographic societies.

We perceive the need first to improve and verify the analytical methodology extracted from auxiliary

sciences. For this reason, in the early 80s we promoted the writings of degree theses on the analysis of strategies for the exploitation of animal and plant resources and soil micro-morphology focused and redirected from Archeology itself. We also explored the possibilities of incorporating new disciplines such as statistics for the analysis of spatial distributions in extensive excavations of settlements (Vila (Coord.) 1991, Vila-Mitjà, Estévez 1989).

Space and social relationships – Assuming that the forms of social organization must have some kind materialization, which is recorded in the structure of the archaeological evidence (Estévez, *et al.* 1984), we follow the idea that the organization of space in Archaeology contains significant information about the social relationships. We discussed and published these arguments in the Colloquiums on Space in Teruel and tested them in the Mesolithic sites of Cingle Vermell and Roc del Migdia in Catalonia (Vila-Mitjà 1985, Vila-Mitjà, Argelés 1986).

Once we knew the spatial distribution of the activities, we needed further a contrasted methodology from which to establish that relationship between a description of the spatial distribution and the social structure.

Faced with this impasse, the essential thing was first to verify whether the methods and techniques of fieldwork and the elaboration of the archaeological record that we had at that time were adequate for an archeology aimed at revealing social organization. We concluded that the essential factors were research in methodology, calibrating the archaeological method, and evaluating and refining the archaeological methodology used for our approach. One way to modify and refine the survey and at the same time develop the methodology was to know the answers in advance and verify to what extent we could get them with the archaeological record. In practice, it was about understanding the defining features of ethnographically documented societies and then identifying the archaeological indicators of their existence, or their consequences (Vila-Mitjà, Estévez 2001).

Ethnoarchaeology as an experiment or instrument to calibrate the method and develop methodology – Thus we arrived at our encounter with Ethnoarchaeology in the midst of the 80s. We thought that Ethnoarchaeology could be used to contrast between the ethnographic sources and the archaeology of synchronous sites of the same society and that this could help us to develop and refine the necessary methodology to try to approach the social organization of prehistoric HFG societies.

That is to say, that archaeological work in settlements of ethnographically well documented HFG societies could offer the opportunity for the theoretical and methodological experimentation that we needed.

We consider therefore Ethnoarchaeology as an experimental interface for methodological development in Archaeology, where the variables are controlled and it is possible to evaluate the adjustment of the methodology. That is why our practice carries now an adjective: it is experimental Ethnoarchaeology (Estévez, Vila-Mitjà 1996).

It was not necessary or pertinent to interfere directly in current societies, nor to carry out new ethnographic fieldwork if we could gather a good extensive ethnographic and historical documentation. The potential information increases specially if this information has also certain chronological depth (starting at the first contacts) in order to purify the biases of the political and social situation of the different observers (Vila-Mitjà 2011, Vila-Mitjà, Estévez 2016).

EXPERIMENTAL ETHNOARCHEOLOGY IN TIERRA DEL FUEGO (TdF)

Our first ethnoarchaeological projects began in 1986. We chose the Tierra del Fuego archipelago and specifically the societies called canoeists, as the main goal (Estévez, Vila, Coords 1996).

TdF and at first instance the HFG canoeist society of the Beagle Channel (called Yamana or Yahgan in Ethnography) offered us those prerequisites (detailed and long term ethnographic information) and had an added advantage. In fact, the Argentine colleagues with whom we designed our first long-term research project had already carried out previous work and had extensive archaeological experience in the region. This fact could facilitate fieldwork and allow us to locate archaeological sites of European contact time that represent the end of a long chronological sequence.

Throughout the many years in which we have been developing our successive projects, many people have been incorporated into our team and have contributed with their work to achieve the objective of approaching archaeologically the dynamics of the economic-social organization of HFG groups. These investigations have given rise to a series of specialized monographs, such as *Treballs d'Etnoarqueologia* edited by the Spanish National Research Council-CSIC (<http://editorial.csic.es/publicaciones/coleccion/115/treballs-d-etnoarqueologia>). Throughout all these research projects we have enjoyed

fruitful discussions with colleagues from other countries, such as Czech Republic, Spain, Portugal, Australia, Chile, Mexico, Peru, Uruguay, Canada, USA, Sweden, Norway and England, with whom we have shared ideas both in fieldwork and in research stays at the respective institutions. All the documents, research reports, literature, analysis, pictures, films are now compiled in the Open access repository: <https://tuit.cat/E37y8>.

The compilation of an objective ethnographic image

- The first step was the critical analysis of all written and photographic ethnographic sources from the seventeenth century to the dissolution of these societies, due to European contact at the beginning of the 20th century. The aim of this critical compilation was to achieve an objective ethnographic image. This image shows the essential features that constituted the social organization, those elements that supported its maintenance and ensured its continuity.

The resulting image showed us that despite the impression conveyed by some ethnographic accounts, all Fuegian people did not constitute an egalitarian society (Vila-Mitjà, Ruiz 2001).

We argue that inequality is materialized (always and also in these HFG societies) and can be objectified by the different degree of effort invested by men and women in subsistence and reproduction. This difference can be measured through the consequences of labor (the analysis of products) and can be objectively evaluated

for every product through the calculation of labor invested with the available technology (*Figure 1*).

This led us to try to measure this differential effort in an objective way through a neural network analysis (Barceló *et al.* 1994, Vila *et al.* 2010) with which we were able to quantitatively and graphically evaluate and demonstrate this inequality between men and women for the Yamana case (Vila, Ruiz 2001, Estévez *et al.* 1998).

After this critical and objective evaluation of the ethnographic information, we conclude that the system was conditioned (limited) by subsistence relationships (the relations between people and resources or the subsistence strategies). The relationships of reproduction (the relation between people to reproduce the system) in its turn were the dominants to ensure the sustainability of the system (Estévez *et al.* 1998).

This conclusion indicates the need to investigate sexual division of roles and the real and assigned value of labor, because social relationships cannot be directly deduced from biology, economic rationale, or simply analogy. For this reason, before beginning the actual archaeological fieldwork, we considered it essential to carry out an archaeological analysis of all the abundant ethnographic Fuegian materials deposited in the European museums (London, Paris, Berlin, Mödling, Vienna, Gotteborg, Leningrad, Florence, Rome, Vatican, Madrid, etc...). These museums contain collections that had yet not been studied from an archaeological perspective and that are very interesting to get a complete ethnographic picture: what kind of artifacts could we directly find, or infer from the archaeological context, or what other material goods would be difficult to induce with archaeological methods? The survey of the ethnographic sources was thus completed between 1986 and 1987 analyzing the whole work processes (discriminating by sex) about the procurement of raw materials, working instruments, work processes, components, and the time involved in the manufacture of all these objects, as well as the potential material residues and the type of waste produced by their consumption.

We did not limit this study to the canoeist society chosen at the first instance but also to the neighboring Fuegian ones (which the ethnographic sources had distinguished as different). In this way, it would also serve us to delimit and verify the potential materialization of traditional ethnic differences (Vila-Mitjà *et al.* 1996, Estévez, Vila-Mitjà 2006b).

We also thought it opportune to see at the same time how far a bio-anthropological study of the human remains

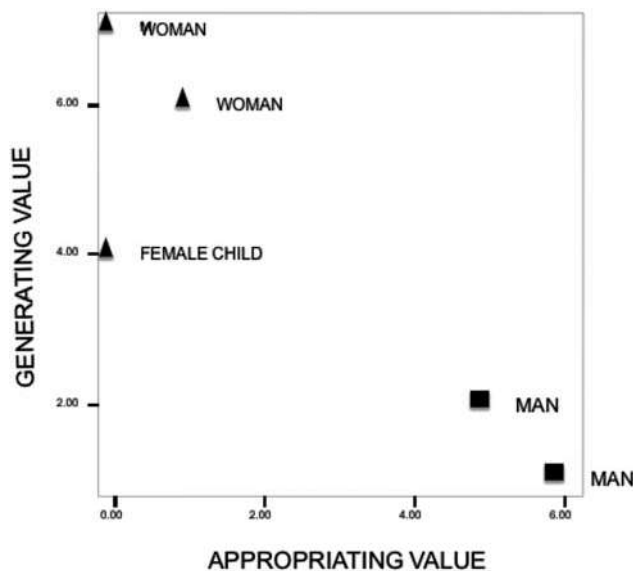


FIGURE 1: Graph of the value produced versus the value consumed in men, women and girls. A clear asymmetry is observed between the adult male and female individuals.

that were located in American and European museums, could go and how could it contribute to our goals. In addition to traditional morphometry, palaeogenetic and dietary analyzes (through the chemical composition of bones and teeth and dental microwear) which were just beginning to develop at that time of the 80s, were carried out (Turbón *et al.* 1988, see also the repository collection ANAME. *Etnoarqueología en Tierra del Fuego: Análisis arqueológico de materiales etnográficos* at <https://digital.csic.es/handle/10261/158444>).

EXCAVATIONS IN TIERRA DEL FUEGO

The fieldwork approach – Once the critical ethnographic image was obtained, the next step was to excavate settlements of the same Fuegian society for which we now had complete social information. After fine-tuning, with our Argentine colleagues, an excavation system adapted to the type of canoeist shell-midden sites, we undertook fieldwork that was to continue from 1988 to 2006.

The excavations were carried out first in two Yamana settlements on the Beagle Channel dated to the period after the first contact with Europeans. They were located in different contexts of topography and access to resources in order to identify biases due to geographical variables. The first, Túnel VII, was a site reused by a social unit on at least ten discontinuous occasions at different yearly seasons (Estévez, Vila-Mitjá 2006c). The second, the site of Lanashuaia, 60km eastwards away, was the result of one or a maximum of two long-term occupations located in a wide beach (*Figure 2*) in which there were signs of many other occupation units (Verdún *et al.* 2016). Later we excavated sites corresponding to activities of a more ideological nature: burials and a ritual hut that had been documented by the main ethnographer who had described this Yamana society. To confront these results, we later did the same in the north of the TdF Island on a settlement and a ritual hut belonging to a different neighbor group that ethnography had identified as Selk'nam (Estévez *et al.* 2007).



FIGURE 2: Lanashuaia site campaign of 1996 in a slightly hilly, open landscape and next to a series of sheltered bays. The excavations are extensive oriented to cope the spatial organization of the archaeological evidence.

We always started from the premise that although randomness and variability are expected, human activity is the consequence of *organizational strategies* (Terradas 2001) that are carried out by women and men in a particular temporal and spatial sequence. Social relations structure the inhabited space as a consequence of the norms that order the distribution of work, consumption, and consumer waste. In short, we had to demonstrate that despite the post-depositional processes, the distribution reflected the social structure itself and the inequality between the members of a group, just as the ethnographic survey suggested.

The extensive excavation of the occupation units was the first requirement to verify the relevance of the thesis on the coherence of social relations and the organization of the archaeological space. Gradually (Orquera, Piana 1992, Vila-Mitjà *et al.* 2009, Barceló *et al.* 2009, Verdún *et al.* 2010, Vila-Mitjà *et al.* 2006) we evaluated and improved the excavation methodology, disregarding lastly the girdle of squares thanks to the incorporation of photogrammetry, digital photography, and computerized data collection systems with topographic stations. We used a microstratigraphic recording system that was supported by a detailed study of fireplaces, soil micro-morphology, units of waste superimpositions, and reassembly of bones and lithics (Suárez-Villagran *et al.* 2010)

The work on "*significant associations of spatial interrelationships*" (Wünsch 1989) quickly demonstrated the existence of spatial patterns and recurring strategies of general organization of space.

In parallel to the archaeological excavations, direct specific oriented experimentation campaigns were carried out to implement an optimized sampling system and to know and isolate the taphonomic processes (Estévez, Mameli 2000, Estévez 2000, Mameli, Estévez 2001). The replication experiments on labor tasks involved in the production of goods (from the construction of huts, use of fire to the production of all the ethnographic documented goods) were also essential to understand the formation of the archaeological evidence because ethnography usually only provides simple descriptions rather than explanations of the actions and behaviors observed. Some of the issues, critical for archaeological reconstruction, can only be clarified by contrasting the ethnographic descriptions with experimental replication procedures.

The analytical tasks – Throughout the successive projects we refined the analysis of the different materials recovered in the excavations. Soon we realized that to approach the social organization in archaeology it is

necessary to change some variables and methods at this practical analytical level and to look at spatial and density analysis in terms of variables that actually bring together categories that are often treated separately. We have to integrate and relate the results of use wear, raw material, and technological analyses of lithic and bone residues, analysis of faunal resources, soil micro-morphology, chemical and phytolith analysis of sediments, and seasonality deduced from osteology and growth structures in bones, teeth and mollusks shells (Estévez *et al.* 2013).

We realize that the analyses of the archaeological material should be aimed at restoring the entire sequence from the identification of the resources actually recognized by ancient people to the final consumption, maintenance, or final rejection of products. In this process, we had to distinguish between residues of the final consumed product and the waste or even the modifications to the environment (like fireplaces, soils...) that would have been generated during their production (Figure 3).



FIGURE 3: Lanashuaia site campaign of 1996. Burnt pebbles and fatty acid embedded soil on the bottom of the shellmidden accumulation. The chemical analyses were made for the sediments and pebbles. The pebbles were also submitted to geological fine slides. The replication experiments allowed us to state the temperature of the fireplace. The whalebone (at left) matches with the results of the chemical analysis and explains the cause of the choice for the first installation at this place.

We developed an alternative method (Vila-Mitjà (Ed.) 1986, Pié, Vila-Mitjà 1992) for the study of mineral resources that allows us to reveal the form-function relationship of lithic instruments that had been masked by the use of traditional typologies (Briz *et al.* 2005). It takes as a starting point the use of the instruments as the main axis to establish significant associations between the morpho-technical variables and discover the socio-economic decisions that underlie the processes of management and consumption of resources.

The study of the strategies for the use of lithic resources (Vila *et al.* 1995) assesses all the steps that begin with obtaining raw material (Terradas *et al.* 1991, Terradas 2001) and its transformation (Clemente, Terradas 1993), and ends when they are used as instruments to obtain other goods (Clemente 1997, Briz 2004).

With the experimental replicas in the case of the lithic material, it was possible to verify with an objective evaluation the coherence of the analysis of the use wear traces using computer image processing and also with neural networks (Vila-Mitjà, Gallart 1993, Pijoan 2007).

The analysis of faunal resources including mammals (Estévez, Martínez 1997, Estévez *et al.* 2001), birds (Mameli, Estévez 2004) fish (Juan Muns 1993), and shellfish (Verdún 2010) answers not only to the questions of biological classification and taphonomy but to how, with what type of instruments they had been obtained, processed and how and where the remains had been consumed and disposed of. We had to evaluate (Barcelo *et al.* 2006) the relative effort invested in the entire process from obtaining the instruments, the prey capture, their processing and the value of use of the direct consumption of the different portions. These were distributed internally inside the occupation unit or shared externally (perhaps with other neighboring occupation units). Juan-Muns (1993) managed to develop an effective sampling strategy for the thousands of ichthyofaunal remains and to determine the exploitation systems and relative weight of the fishing resource. The same could be achieved for the remains of mollusks (Verdun 2010).

The work of Piqué (1999) on the use of plant resources together with the experimentation on the functioning of fireplaces carried out by March (García-Piquer *et al.* 2018, March, Wünsch 2003) demonstrated the especially critical nature of wood as fuel. The collection of wood was not carried out randomly but selectively. The existence of good fuel in the neighborhood and the availability and speed of recovery of harvested beds of mussels (which were the basic daily food resource) strongly conditioned the dynamics of

space occupation and the mobility of these groups. The morphological and chemical analysis of fireplaces also made it possible to establish different types of fuel and other materials used and processed (Lozano 2018) there. The analyses of carbonized seeds allowed us to re-evaluate the contribution of work in plant gathering, which, like that of fuel, has normally been little taken into account both by archeology and ethnography (Berihuete 2006).

The analysis of the phytoliths, (Zurro 2010, Zurro *et al.* 2009) as well as the chemical analysis was carried out by means of horizontal sampling. The results were correlated with the spatial analysis of the associations of architectural elements (post hollows marks) and other significant elements (zones of passage, waste evacuation areas...). That allowed us to recognize what materials were used and how the huts had been built and to evaluate the work effort invested.

The internal dynamics throughout each occupation period could be traced thanks to new approaches to the formation processes of the sites. The fine sequencing of the debris could be established through the micro-stratigraphic analysis of the sequence discriminated in the excavation (Estévez, Vila 2000) together with the analysis of repairs, reassemblies and re-articulations, as well as by significant taphonomic marks such as trampling bearing, polish and fractures (*Figure 4*). The studies of micro-morphology that were applied for the first time in a shell midden (Taulé 1996, Suárez-Villagran 2012), allowed us to verify the microstratigraphic conclusions and the formation processes of the site (*Figure 5*). This occupation dynamic was completed analyzing the seasonality on the growing structure of fishes and mollusks (Colonese *et al.* 2011).

With this refocusing and intertwined analysis, we were able to move on to the study of the strategies of social organization of space (of the production, consumption and disposal processes) that had been the initial objective.

The spatial distributions of the occupation units went through the taphonomic and microstratigraphic filter. In these aspects, the contributions of taphonomic experiences following biostratigraphic processes in the area (Estévez, Mameli 2000, Mameli, Estévez 2001) and post-deposition marks as well as micro-morphological analysis proved to be fundamental (Balbo *et al.* 2010). The quantitative and geo-statistical treatment was refined from the first powerful but relatively simple self developed system (Wünsch 1992) of "Analysis of Spatial Interrelationships" (ANITES) to the use of correlograms and variograms (Castillejo



FIGURE 4: Refitting lines of 1555 bones in Túnel VII site. The analysis of these lines allows a fine stratigraphic dissection of the deposition process of consumption. Above, rearticulated portions of a vertebral column of one sea lion.

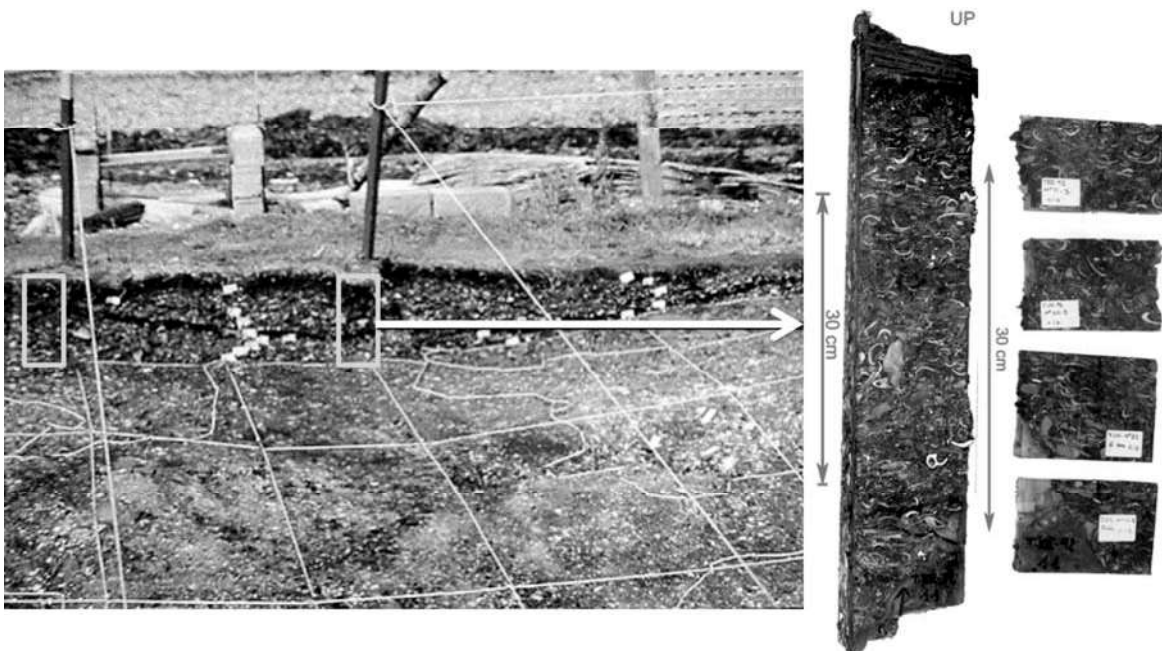
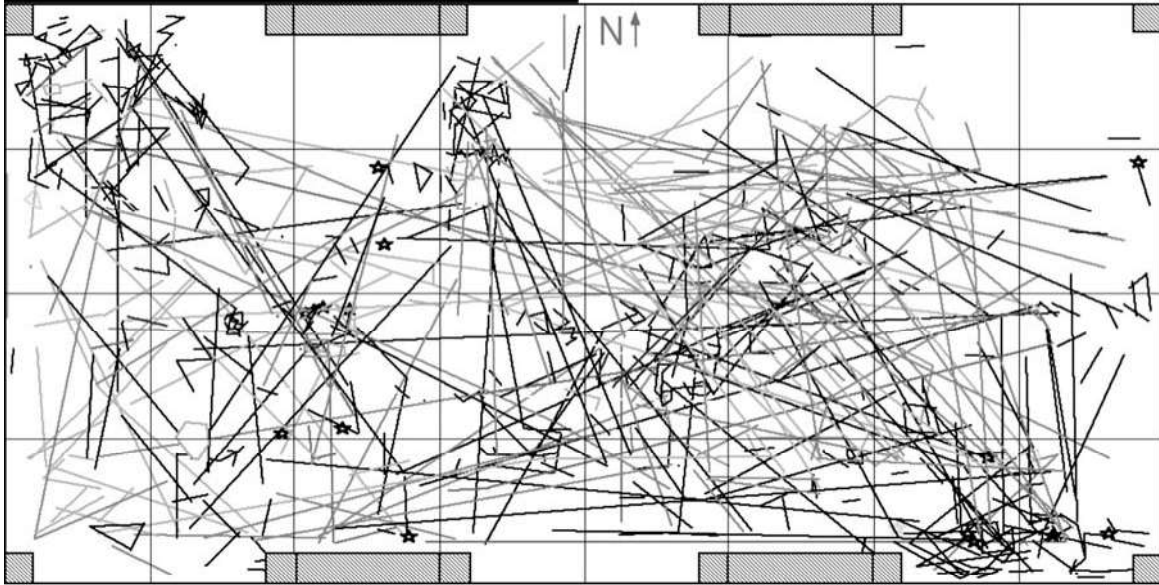


FIGURE 5: Micromorphology samples at the Túnel VII site. A box of the entire stratigraphic sequence was taken and then it was separated into a series of thin slices for microscopic analysis.

2007) and the Fuzzy clustering method, following the improvement of software and computer hardware and conceptual instruments (García-Piquer 2018). Such analysis is based on a more qualitative research that emphasizes the definition and association of categories in order to detect socially significant observation units (Figure 6).

As we have stated (Barceló *et al.* 2006, Vila-Mitjà *et al.* 2010, García-Piquer 2019), the application of the calculation of the real, or produced, value and the possibility of its quantitative evaluation has allowed us to globally understand the differences in the investment of time, that is the real value generated by men and women in production. We could also determine the real amortized value by the agents benefited by its consumption of the products. That could be applied to spatial analysis identifying and locating areas of residues representing different consumption values. The spatial interrelationships present recurrences throughout the sequence of occupations of the occupation units, evidencing the existence of a similar and recurrent organization of the social space. That can be read as the result of a repeated strategy of the use of space by the different agents and thus as the consequence of

social norms that maintain the social order (social division and inequality).

The correlation stated (García-Piquer 2018, García-Piquer, Estévez 2018) was the objective of an ethnographic survey in other HFGS, which demonstrated that the division of social space can effectively act as a mechanism to naturalize the sexual division of labor, and vice versa, this division is used to justify the division of space.

Spaces of social reproduction - ceremonies - The ethnographic information allowed us to analyze the ritual ceremonies as well as their stories and myths and to relate them to social production and reproduction. Ceremonies and stories or myths are social products and at the same time instruments intended to maintain and reproduce specific social relationships between women and men that make these social systems and their continuity possible (Pedraza 2013).

It is important to study them as products integrated with the rest of social production and not as isolated elements, since they are not autonomous entities but rather integral parts of a whole that can be explained as articulated and interrelated processes.

For this reason, we considered that it was essential to complete the experiment by excavating also

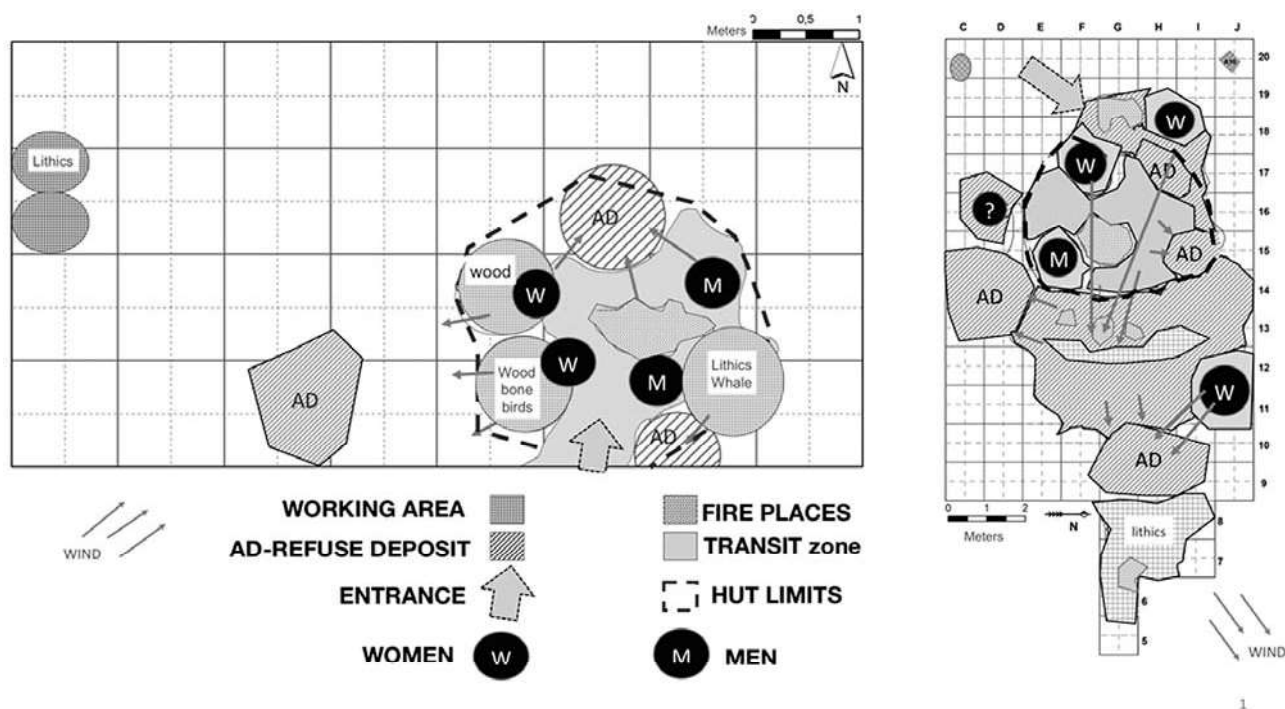


FIGURE 6: Distribution by sex of activities and waste areas in the settlements Túnel VII first occupation (left) and Lanashuaia (right). Arrow lines mark the destiny of refuse from production to deposition areas.

ceremonial-type units. The first of such sites recovered and excavated was Cabaña Remolinos at the center of the Beagle Channel, a place and ceremony exhaustively described by the ethnograph M. Gusinde. Later we excavated Ewan I, also a ceremonial place corresponding to the Selk'nam society of the north of the island (Mansur *et al.* 2007, Mansur, Piqué 2012).

We concluded that the only way to determine through archaeology the ceremonial character was not based on the elements present but on their treatment and on the architectural characteristics (size and location) of the structure compared to the regular occupation units. In the ritual processes there was consumption and a different treatment of the residues, a special consumption of vegetable elements that leave no other trace than special remains such as phytoliths, charcoals and that should leave a particular chemical signal in the sediment. This could be also noticed in the coastal Alaskan HFG ceremonial sites in Salis (2015) pioneering ethno-archaeo-musicological study of Alutiiq, Yupik and Inupiaq ceremonial sites.

Funerary practices – These are an ideological issue that could especially reflect the social organization. For this reason, in our ethnoarchaeological work we also pay attention to it (Vila-Mitjà *et al.* 2006). We excavated two burials in the Beagle Canal zone, to which a more extensive specific program from our Argentine colleagues was added (see Piana *et al.* 2006).

More recently, the work carried out by Carracedo-Recasens (2021) on these practices expanded to the entire area of TdF, where Ethnography located three different ethnic groups.

He showed that there was no clear border between the practices in the different language groups. This fluidity between groups that spoke different languages and that ethnography had separated coincides again with studies of ethnographic material in museums. It also fits with the results of the paleo-genetic analyses carried out by Daniel Turbón's bio-anthropology team (Lalueza *et al.* 1996), in which a genetic flow of women from the canoeing groups to the terrestrial groups to the North of the TdF Island was perceived.

It has been possible to verify that there are no significant diachronic differences from the first archaeologically documented moments to the period of contact and disintegration of these societies, just before their conversion to Christian funerary practices. This conservatism, in theory, would make it possible to add a more consistent corpus in prehistoric cases. One of the data that can be obtained in this way is the demographic structure of mortality (of sexes and ages) of a population.

There was a wide variability in the types of burials and their locations but no significant differences between groups. The variability is clearly related to the mobility of these communities and the temporary accommodation to the environment and even to seasonality or the circumstance of death. For a social analysis the emphasis should not be placed on the shape, position or location of the burials, but on the objects associated with the body and on the analysis carried out on the skeleton.

The shape of the burial or the presence of grave goods does not clearly mark the difference between men and women that we knew actually existed. But men are associated with the exploitation of terrestrial resources and women with a marine-terrestrial combination, although this is not documented by the objects themselves but by their function, the tasks carried out by the deceased that must later be confronted with the bio-anthropological analysis. The study of enthesopathies and paleopathologies continues to be an essential source of information for the reconstruction of activities to distinguish the division of activities based on sex.

The analysis of the diet through isotopic values and dental microwear also has detected different tendencies in the diets of women and men (Carracedo 2021 and see also Estévez, Prieto 2016).

As expected, it has been shown that the social difference between the two sexes can be better detected in their own bodies. It is clear that to get a complete picture it is necessary to sex the individuals, something that cannot always be done using morphometry but can be achieved through paleo-genetic analysis.

The stable isotopes allowed us to notice a possible movement of women between different areas and perhaps indications of inequality (women were displaced to other groups while men did not).

Summarizing the human body is in itself a means of production and reproduction, the traces of use, wear and tear, and the marks of production should be perceptible in that same instrument. In the body or skeleton, like any instrument, is the most direct evidence of its wear and tear, an in this case that means evidence of the social life and the function that they have fulfilled.

All that arises the conclusion that it is essential to carry out a combined interdisciplinary study and not separated by the different disciplines or specialties. It is necessary put together the analysis of occupation units with those of ideological character.

Reflections from TdF – The most important conclusion of this long ethnoarchaeological experiment throughout several research projects, is that archeology can indeed approach the question of social organization and

determine the existence of social norms in HFG societies (Carracedo-Recasens, García-Piquer, 2017) and that it is possible to recognize social inequality. But if, and only if, the methodology is reconsidered and reoriented to answer the new questions.

Another conclusion of our ethnoarchaeological work was to demonstrate the invalidity of an ethnic-cultural approximation through the archaeological materials recovered in the excavations of HFG sites. Far from the four homogeneous and discrete social entities described by the Ethnography, in TdF there was great permeability and flows of information and people between supposedly discrete *ethnic* groups (Estévez *et al.* 2002). We have to keep in mind that sometimes the existence of ethnic boundaries could be simply the result of projections of political misconceptions arising from a particular anthropological theory (notably the particularism of the German school of Cultural History).

TdF people, as is probably true for most HFG societies, were dynamic, flexible, and capable of rapid change, even prior to the period of European contact and ethnographic observation. There is no simple, stable and successful adaptation, but a dynamic attempt to maintain stability in the social system because there are always elements of economic irrationality or occasional, opportunistic and circumstantial solutions that must be evaluated.

Therefore direct inference from ethnography used to explain archaeological evidence, does not always conform to reality. Ethnographic observations tend to generalize and simplify organizational strategies in a non-statistical and subjective manner, characterizing particular observations as norms rather than as variations of practices (Mameli *et al.* 2005, Terradas *et al.* 1999). Instead archeology may encounter particular features but can detect the recurrences due to the existence of actual, not always conscious operating norms.

HISTORICAL PROCESSES AT THE EXTREMES

In 2008, the accumulated experience and the positive results (both technical and theoretical) achieved in the work we developed at TdF advised us to continue testing the validity of the approach. We decided to analyze the societies of the coast of British Columbia, the traditionally called North West Coast (NWC) culture area. Just as in TdF there was abundant and long-lasting ethnographic information and there was already an archaeological investigation that covered the entire sequence up to the

ethnographic period. It was necessary to explain why the processes of social development at the geographical extremes of the American Pacific coast resulted at the end in very opposite social organizations, despite the apparent environmental and resources similarities.

It was the most pertinent next step in our theoretical and methodological *demarche*. Comparing these two developments may be a way to understand the intrinsic features and fundamental causes of change in HFG societies and the best way to delimit the elements of circumstantial variability and isolate the fundamental ones (Vila-Mitjà, Estévez 2016, Vila-Mitjà, Estévez (Eds.) 2010).

The analysis of subsistence strategies of both sequences as we have exposed in detail in Estévez and Vila (2013) is extremely interesting because it illustrates the complex interplay of different causal levels, a combination or succession of trigger (environmental or social) effects of changes in the historical course of the two zones can be glimpsed. Both follow a parallel course that is interrupted in a break that occurred around 4000BP in TdF and about 500 years later in NWC. The emphasis on the collection of mussels in a subsistence based on coastal resources was interrupted. The quasi-synchrony of the two parallel events points more towards a problem due to over-exploitation than towards a fundamentally environmental causality. The crisis was resolved in a different way. The differential development afterwards of the historical trajectories in both zones was the result of a different management of reproduction throughout two divergent historical processes, rather than the mechanical result of different environmental impositions or alternative resource management.

In the late NWC the strategy was intensification of the exploitation of resources that led to a spiral development: The great potential of production (and later of storage) was conditioned to the availability of enough (women) labor force. From our point of view, it is probable that this system was freed of the central contradiction between production and reproduction: The more (female) labor invested in processing the fish captures the more product was obtained because a large amount of biomass could potentially be extracted without menacing the continuity of the reproduction of the main resource. This put pressure on reproduction and as a side effect on social organization that invested huge efforts for managing, controlling and catching of labor force (*Figure 7*).

Instead of an increase of the labor effort of men and women that would signify improving the canoes, collective net fishing, constructing fish traps along the

coast, the strategy in TdF was reducing human reproduction to a sustainable level. This allowed continuing to rely on a relative stable supply of mussels, fishes and sea lions coming from breeding grounds, which were far from easy access with the available seafaring technology (Estévez *et al.* 2002, Piana *et al.* 1992).

Our thesis is that in HFG societies the dominant contradiction in the relationship between the demographic grow tendency and the reproduction rhythm of exploited natural resources could be solved in setting different social strategies. The parallel development of the early sequences and the relative fast divergence later in both extremes of the Pacific Rim is a good example. The strategies followed for management of reproduction did not produce the same effect in the NWC as it did in TdF despite having some starting

conditions, which have been rather similar in terms of time costs and the types of resources initially exploited.

The conclusion of these studies has reaffirmed that the differences and therefore the paths of development/continuity of HFG societies do not depend on the resources primary available but depend basically on certain alternative options that affect reproduction and its norms.

SIMULATION WITH AGENTS OF THE EFFECT OF SOCIAL NORMS

The Yamana Sim project: An experiment in the efficacy of inequality norms between men and women for the control of reproduction. Could reproduction have been effectively regulated through social norms? What

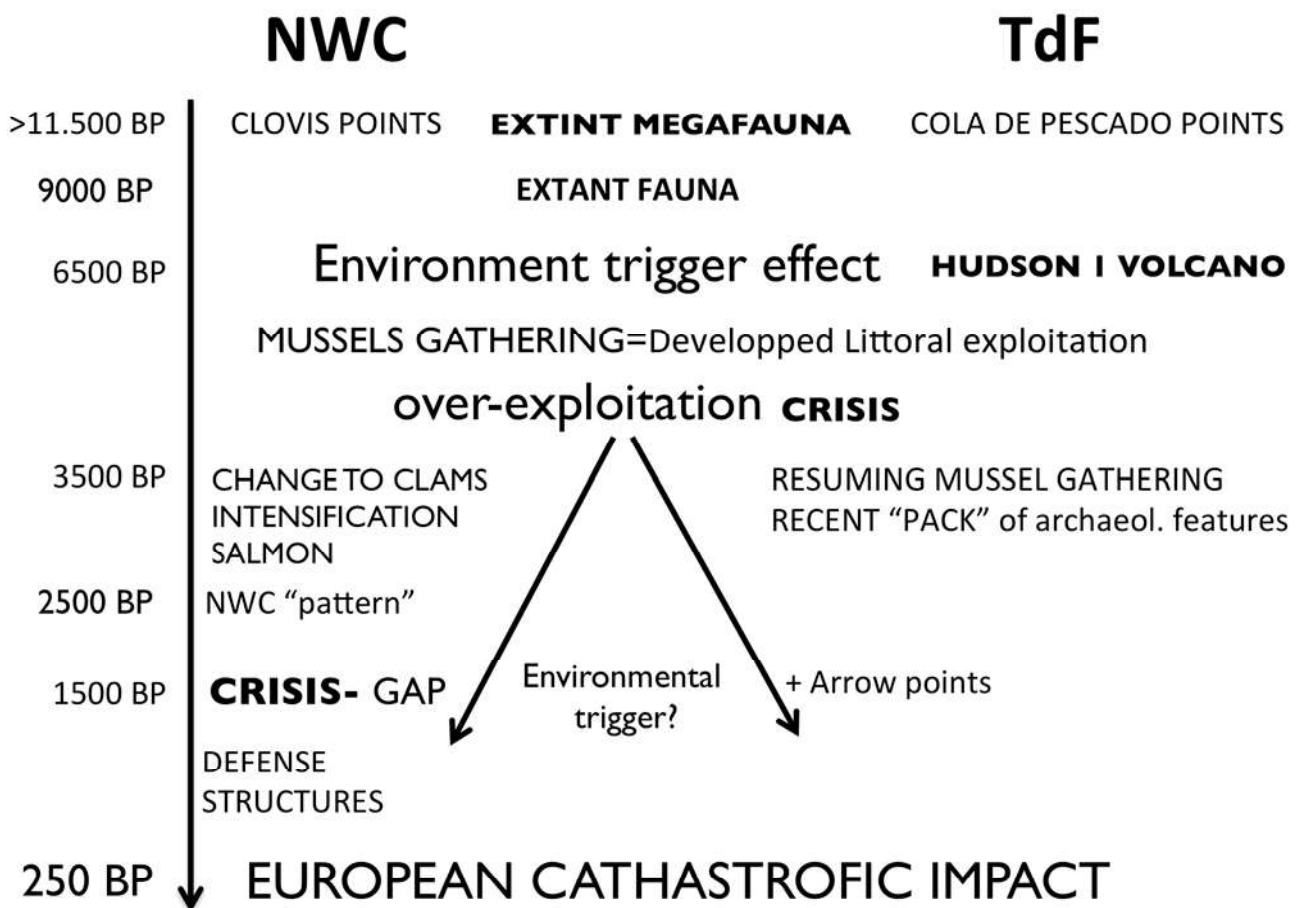


FIGURE 7: Schematic timeline comparing the sequence in TdF Yamana society and NWC Coast Salish. After a crisis, the starting similarity becomes a divergence in the two areas that ends with a catastrophic European impact for both societies.

relationship did the inequality and discrimination of women have with the control of reproduction? How could this inequality have arisen and how has it been structured and sustained? To get closer to some answers, we decided to continue the experimentation but in this case using Artificial Intelligence resources, specifically Agent Systems to simulate the operation and effect of the rules on a virtual society. In the first interdisciplinary project (MACNORMS Intramural Border Project PIFCOO-08-00017. 2008–2010) participated specialists in Archaeology, Anthropology, Economics and AI for an approach to the role of already known norms in the

continuity of Yamana society. We simulated society using the parameters and norms of this society itself (Figure 8).

We proposed a norm-centric simulation (in contrast to the traditional resource-centric simulation) where the normative system was both the core of the simulation and the subject of study. Our final goal was to set the foundations of a rather general model of social behavior in a HFG society without political institutions but with strict social norms. At a first step the social behavior considered by default has been isolated. We tested just the effect of death rates and fertility of the available

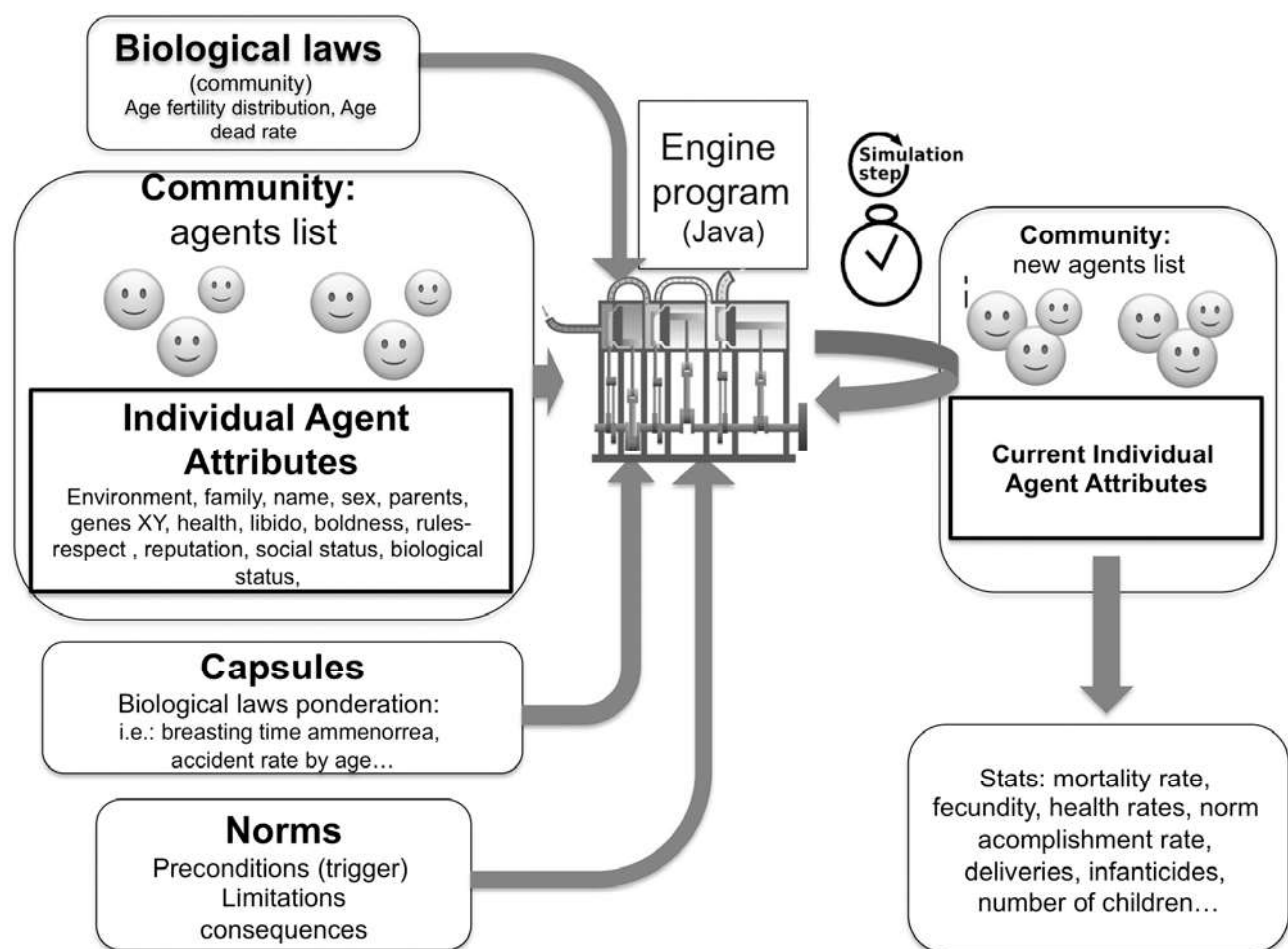


FIGURE 8: Application operation scheme ARESOCARE. The engine (programed in Java) is feed with a biological data set including age dead rates, age fertility distribution and other parameters (abortion rates...); a starting population or community of agents. The agents have a set of inherited or from parents acquired (simulating education) characters – such as genes X and Y, fertility, health, libido, rules respect, boldness and other set of characters that will be changed during the life and experiences of the agents. A set of biological-social capsules is feed, and finally the norms with preconditions, limitations and consequences are introduced. The output is saved in two main files: one contains all the evolution of the whole system through time and another with the state of the community at the final time-point chosen.

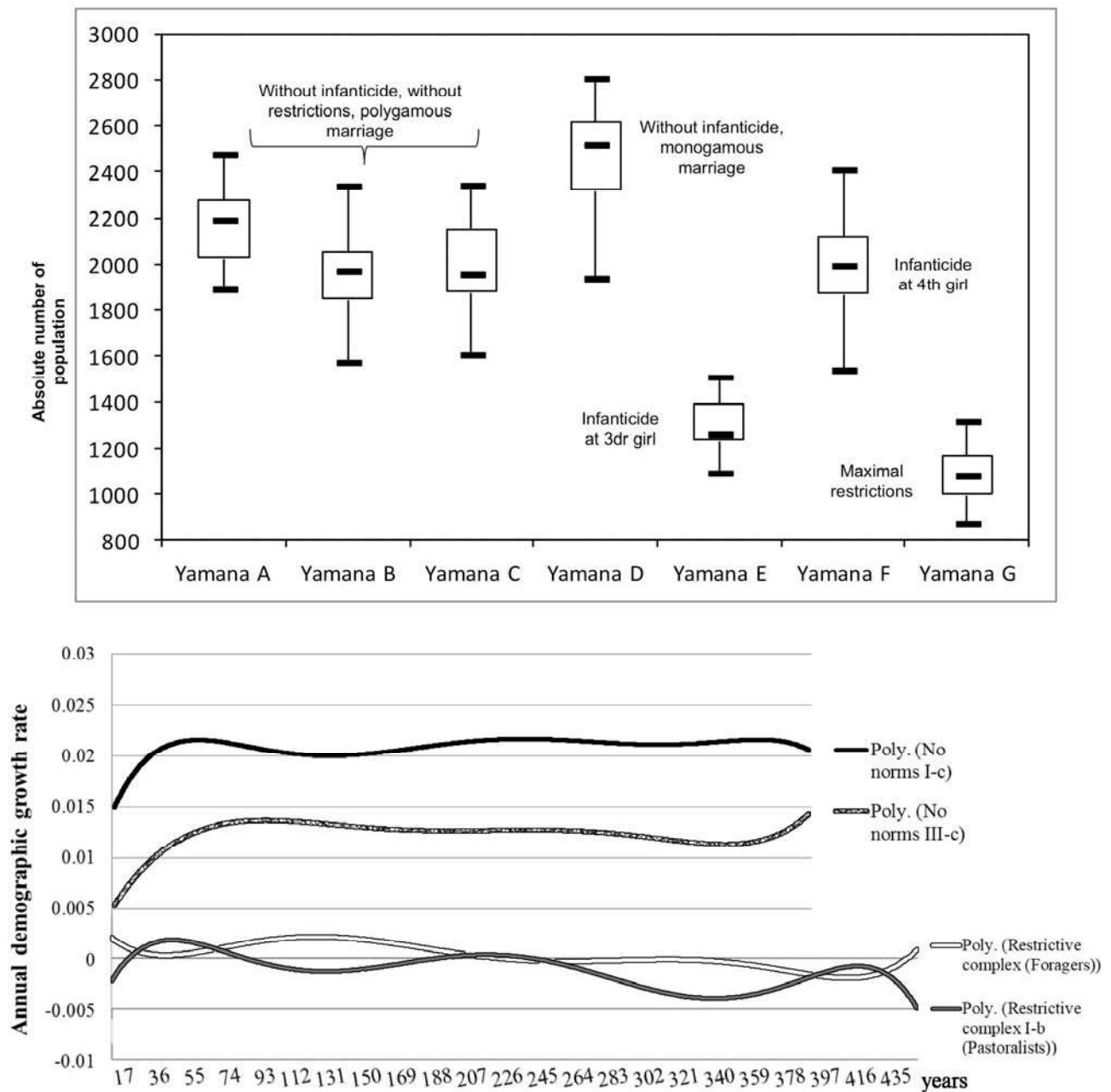


FIGURE 9: Above: First essays changing norms with the Yamana Sim application: Global population after 100 years \times 30 essays starting with a population of 614 people. Infanticide of the third girl would be a good way to reduce demographic grow (simulation Yamana E). The application of the whole set of yamana norms reduce effectively demographic grow (simulation Yamana G). Monogamous versus polygamous marriage increases grow rate. Bottom: Polynomial line for the variation of the growing rate for Khoisan simulation: The two lines above: two essays without restrictive norms but polygamy. The two lines on bottom the stability of foragers and pastoralists with all the set of actual restrictive norms.

contemporary HFG societies and general demographic parameters (Cruz *et al.* 2010). That served us to cope the problems and issues that had emerged during the development of our own multi-agent system application (ARESOCARE). We would use it to test the hypothesis about the impact of social norms that affect the reproduction of small-scale societies (Vila *et al.* 2013).

In the first essays we used the issues of the literature on medical and biological human reproduction. It becomes clear that the biological potential of the human reproduction is incredibly high on absence of restrictive social norms. It also emerged that there are many *apriori* misconceptions in ethnographic literature (for instances that prolonged breastfeeding among contemporary HFG was one of the main factors limiting the number of pregnancies per women). Indeed the high variability of different growth rates, the capability of achieving high growing rates documented in HFG and in simulations without social restrictions, contrast with their long-term demographic stability. Therefore the first hint to point is that the demographic development of HFG societies is not constrained by natural factors, but mainly by socioeconomic factors and social norms.

Our experiment then continued by introducing Yamana norms of reproduction, which also entail social inequality and an undervaluation of women. We constructed the agents society with the biological parameters (mortality, fertility...) and organization of this human group (number and composition of groups). We then subject the agents to successive experiments combining and playing with the different rules related to reproduction described in Ethnography and some potential alternatives: mating age, requirements and marriage system – polygamy versus monogamy –, infanticide, sexual taboos, reproductive partner selection criteria – such as prestige, health... to isolate the effect of distinct actual rules.

With the experiments, the effect of norms as a regulator (*Figure 9*) of reproduction became clear.

Definitely in this case and going back to our first theoretical frame, we consider that the division of labor organizes the roles of the people, which ultimately ensures and supports the maintenance of the social inequality. The way in which labor is divided (organized) is at the same time the manner in which the social assigned value of the productive contribution of the individuals participating in the production is distributed. Labor represents the means through which social relations and social behavior (including reproductive norms) are easily controlled. The difference in production activities according to sex makes it also

possible to set an interdependence between the two sexes (assuring reproduction and continuity) and at the same time to relativize the value of the product obtained, and by extension, the value assigned to the people producing it, which can be identified directly (Perez-Rodriguez *et al.* 2016).

Finally, the incorporation of the discussion (Pedraza 2017) of the concept of prestige (as well as the archaeological materialization of prestige) made it possible to visualize how structural violence produced and maintained social inequality (Vila-Mitjà *et al.* 2016).

But was the correlation between rules to control the reproduction and division of labor and discrimination against women in Yamana society just a special case? Could this result be extrapolated to other HFG societies?

The simulation of the effect of social norms: Paleo-demography. – The questions to answer were: Is the use of social norms a mechanism to regulate the behavior of individuals and social relations of reproduction? To what extent does the normative system of a HFG society affect its reproductive capacity, by increasing, stabilizing or decreasing it?

The simulation with agents that we had developed for the Fuegian case allowed us to introduce and extract norms in the system to verify their effect on the reproduction rate of these societies in the short and medium term (Olives 2019).

Thus we could assess the effect and longer-term impact of specific social regulations of reproduction. It was thereafter expected that the result of the simulations could verify the main thesis: HFG developed social norms that effectively regulated demographic growth, in order to prevent an excessive demographic pressure on the carrying capacity of the environment.

For this reason we continue testing in an international project (*Ethno-archaeological Analysis of Reproduction in Hunter-gatherer Societies* 2011–2014) with the participation of M. Gándara (INAH – Mexico), I. Davidson (UNE – Australia), C. Grier (WSU – USA), M. Pérez (ESPOL – Ecuador), J. Salius (UAB), M. Blake (UBC – Canada), E. Mansur (CONICET – Argentina) and Alfredo Prieto (UdM – Chile). We would apply the program to other different HFG. We replicate the structure and the social norms relating to the reproductive behavior of five particular ethnographic societies (the Yamana and Selk'nam of TdF; the Coast Salish from the Canadian West Coast; the Yolngu of northeast Australia and finally Khoisan people of SW Africa). The ultimate goal of this project is to see which social norms are crucial in regulating reproduction.

At the moment, in addition to carrying out the verification with Yamana and Selk'nam norms, as a next example it seemed especially relevant to us to study the population of Khoisan because there is a wealth of information of more than 500 years and it is possible to play with combinations and descriptions of norms collected at different times and by different rapporteurs. These people have been extensively studied from social anthropology, linguistics and demography, generating the analogical paradigm of HFG so often uncritically exploited in archaeological studies of prehistoric HFG. Olives (2019) compiled all these information and simulated not only the hunter-gatherer (San) but also the pastoralists (Khoi) to improve the contrast of the experiments.

These sets of simulations in the four groups have shown so far that it is possible to control the population growth within a sustainable size just by social norms. They have also shown that one single norm may have the opposite effects if combined with other different social norms. In short, that to be effective, the rules must be combined and structured with each other (see Figure 9).

Demographic growth is effectively regulated with social norms that affect specifically the social and reproductive behavior of women. Therefore, the availability of women is an important factor that conditions the growing trend of the entire population in the long term. Acknowledging this interrelation, it is clear that a population, whose subsistence is based on the wild resources, would develop several mechanisms that would regulate the sexuality of women and their role in reproduction.

The establishment of such dissymmetry between the sexes requires of course an ideological frame that legitimizes it and conveys the established organization towards the following generations.

Our methodological approach allows us to test the theory about the importance of controlling reproduction for the survival of all HFG societies, and experimentally explore the operation of those societies to deepen our understanding of social processes.

In addition, we hope to raise new hypotheses that make us look at the archaeological record again. A potential for future could be to proceed with the investigation of the archaeological materialization of these norms, as we have been able to propose for TdF.

Looking back to prehistoric HFG, that was the last scope of our trail, we have use (Olives, Estévez 2016) our Agent System application to test the hybridization of two societies with a slightly different reproduction

rate as it could be a result of a different body mass (like the Neanderthal case compared to the modern human form) and its consequences on variables such as maturation age, weaning... We have followed the resulting population by introducing male and female lineage tracers (simulating DNA mitochondrial and Y chromosome). The rapid decline, in a few hundred years, of the population with original chromosomes of the robust population (ie. Neanderthals) was a surprise and raises the plausibility of a dilution hypothesis of the ancient human form in the modern population.

FINAL DISCUSSION

Our journey from Paleo-Mesolithic archeology to the use of Agent Systems to analyze the role of norms in the dynamics of HFG, passing through Experimental Ethnoarchaeology, has shown us the importance of the reproduction process (the axis of the social and economic organization of developed HFG societies). Our ethnoarchaeological experience in TdF has shown us that the organization of these societies is *archaeologized* in materials and sites. The social relationships could be retraced directly from the archaeological record without relaying any more on ethnographic extrapolation.

To achieve this goal, however, it is essential to change the whole methodology from fieldwork to the analytical categorization of materials and their interrelationships.

We think that an extended use of ethnoarchaeological experimentation in as many ethnographic and contemporary archaeological contexts as possible should help to develop markers that would allow archaeologists to approach work processes that are invisible, or hard to see in the material record and even associate them with social agents.

It is possible to look for the role played at each "moment" by this interaction between the normative elements of social organization and resource exploitation strategies. Our theses on the historical dynamics of this relationship can today also be submitted to evaluation with the use of agent systems and artificial intelligence.

We have demonstrated the centrality of the management of reproduction in hunting-gathering-fishing societies and we claim that this necessary management could have generated a social organization in Prehistory in which women are subject to structural violence (Vila-Mitjà *et al.* 2016). Our attempts to identify this form of violence lead us to reconsider the goals and possibilities of archaeological science.

Being able to prove or refute the existence and causes of subordination and structural violence against women in prehistoric human societies would provide us with a solid basis for the debate on the naturalization of behaviors and destinies of women and men.

Thus we could end feminine and masculine essentialisms that justify current supposedly immutable social roles (Vila-Mitjà, Estévez 2010, Vila-Mitjà (Coord.) 2017).

Indeed this was our first hypothesis and still remains a goal for future research (Vila-Mitjà *et al.* 2017).

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