

## 8. Last Foragers in Coastal Environments: A Comparative Study of the Cantabrian Mesolithic, Yamana of Tierra del Fuego and Archaic Foragers of the Central American Coast

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*In recent years coastal foragers have emerged as a recurrent topic in discussions of explanatory models for complexity. These discussions have generally emphasized the concept of “affluent foragers”, where complex coastal cultures arose because of abundant and attractive littoral resources. An alternative perspective sees the colonisation of coastal areas and consumption of littoral resources as an intensification process caused by demographic pressure and a decrease in terrestrial collecting and hunting productivity. In this paper we present the results of many years of archaeozoological and ethnoarchaeological research in three different contexts where forager societies exploited littoral and marine fauna to various degrees. The analysis of food production through vertebrate and invertebrate fauna consumption allows an evaluation of the economic foundations of coastal hunter-gatherer societies. The comparative study of three geographically disparate situations allows for the dismissal of strict environmental causality as a primary explanation for the development of coastal adaptations. More satisfying explanatory models are proposed that consider both the economic and social characteristics of these coastal hunter-gatherers, and the broader problem of their evolutionary change to domestication economies is addressed for cases where this transition occurred.*

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### **Introduction**

After a history of neglect the study of littoral adaptations among hunter-gatherer societies has become a recurrent topic of archaeological discussion over the past 25 years. This new focus produced the realization that the exploitation of littoral and marine resources by foraging communities became widespread only at the beginning of the Holocene. To explain the change in theoretical perspective on the importance of littoral hunter-gatherers it is necessary to refer to a variety of trends in archaeology that are difficult to summarise in only a few words. Having said that, and at the risk of oversimplifying the issue, three main causal factors can be identified that are to a great extent linked to transformations that brought about processual explanations in our discipline.

First, the definition of culture as adaptation focused attention in the 1970s and 1980s on the impact that ecological factors have on social behaviour. For many

scholars, the limited technological development of hunter-gatherer societies meant that they were even more at the mercy of the environment. This was a continuation of the theses defended by scholars such as Leslie White and Julian Steward. Binford's (1980) classic division between foragers and collectors and Jochim's (1976) work provide more recent examples of this vein of thought. In this tradition, marine and littoral environments, which were markedly different from an ecological point of view from those found inland, were treated as distinct contexts that had a very specific effect on the foraging communities that inhabited them (Perlman 1985; Hassan 1981). A related question was why these environments were colonised in the first place. For some authors, littoral areas were marginal environments and their settlement by human groups was driven by imperatives, such as those resulting from demographic pressure upon more favoured ecological niches (Cohen 1977; Osborn 1977).

Other authors considered coastal environments to be extremely rich in terms of biomass and therefore believed their settlement to be due to their economic attractiveness (Birdsell 1968, Perlman 1980, Sauer 1962, Yesner 1980). These disparate views generated productivity studies of different ecosystems, the demographic dynamics of pre-agricultural groups, and the capacity of these groups to respond to a variety of internal and external pressures.

Renewed interest in paleoeconomics within archaeology is a second factor, and this development is partly interrelated with the first. If pre-industrial groups are mainly adaptations to ecological circumstances, it is then necessary to understand how different cultural options provided solutions to these pressures. In this regard, the English tradition of archaeology begun by G. Clark focused much attention on pre-Neolithic littoral adaptations in some areas such as the north of the Iberian Peninsula (Bailey 1978). The application of the economic theory of diminishing returns by Boserup (1965) opened another line of research linked with the belief that coastal environments were marginal areas. Other work (Earle and Christenson 1980) developed these propositions with premises similar to Cohen's (1977), which easily dovetailed with proponents of the Optimal Foraging Theory (Smith 1983; Winterhalder and Smith 1981). More recent work from this perspective situates the exploitation of marine and littoral fauna within the framework of a progressive drift towards a diet of low-value resources. This drift would have been the result of the evolutionary pressures faced by hunter-gatherer groups: demographic growth, geographical circumscription, technological development, and increased competition (Broughton 1994, 2002; Hayden 1981, 1994). In some cases these pressures were produced by environmental changes, such as the post-Pleistocene marine transgression. This view also coincides with theories about the importance of demographic pressure caused by the reduction of available land, which is used to explain the drift towards farming communities (Binford 1968).

Third, with the studies of the !Kung and Hadza, among others, at the end of the 1960, ethnographic studies provided archaeology with the inspiration to learn about different aspects of the social behaviour of foraging societies. These studies supplied the necessary quantitative base for the development of many archaeological models (e.g., in the calculation of labour time, duration of settlements, etc.). Nevertheless, the increased familiarity of archaeologists with ethnographic sources, particularly the affluent societies of Northwest America, started a debate about the levels of social inequality associated with this kind of society and the supposed universality of "primitive communism". The work of Price and Brown (1985), Bonsall (1989), and Testart (1982) was the starting point for the study of the complexity among hunter-gatherer societies. Much of the evidence for social complexity appears in the Holocene within the context of groups settled on the coast and whose econ-

omies were to a greater or lesser extent oriented towards coastal and aquatic resources. This observation brought together the study of the last manifestations of hunter-gatherers, analysis of the exploitation of littoral resources by foraging communities, and social complexity in pre-agricultural contexts.

In this paper, we adopt a cross-cultural perspective by examining diverse cases of post-Pleistocene hunter-gatherer groups that exploited coastal areas (Fig. 1). We first present the results of research in Tierra del Fuego, where groups of canoeists subsisted for 6000 years up to the beginning of the twentieth century. Second, we look at the latest research into the last foraging groups of the north of the Iberian Peninsula and their relationship with Neolithization processes. Finally, we present data that permits us to sketch a preliminary outline of the end of foraging economies of the Caribbean coast of Central America and the incipient cultivation of specific plants. In all cases the way in which production was organised decisively affected the evolutionary trajectories that emerged within these societies. We present three case studies to demonstrate that environmental relationships are incapable of providing a satisfying explanation for the way in which various littoral foragers organized themselves. Elsewhere we have made extensive analyses of the hunter-gatherer mode of production (Estévez et al. 1998; Estévez and Vila 1998; Gassiot 2000, 2002a). Here, it will suffice to state that we assume hunter-gatherer societies exist in a changing context that is the product of their own contradictions and internal tensions, and that these tensions are fundamentally of a social origin. In other words, despite the fact that ecological factors derived from the type of biomass available from the environment may play a role in shaping change in a society, the origin of organisational shifts should be sought in the different methods of production of the means of subsistence and, above all else, in the social relationships that are generated as a result. In the last part of the paper, this perspective serves as a base to synthesise a number of regularities associated with the economic exploitation of littoral environments in different geographical and climatic contexts. The identification of shared factors allows us to look for causalities of a social nature in the production sphere.

### **Tierra de Fuego: A Long Unbroken Stability and a Tragic End**

The shellfish gathering, fishing and hunting society of Tierra del Fuego at the southernmost tip of the South American continent is the subject of our first study. Interest in these hunter-fisher-gatherer societies is paradigmatically linked with the formation of Western ethnographic thought. The influence of these societies on the development of evolutionary thought following Darwin's voyage on the *Beagle* is undeniable, and they

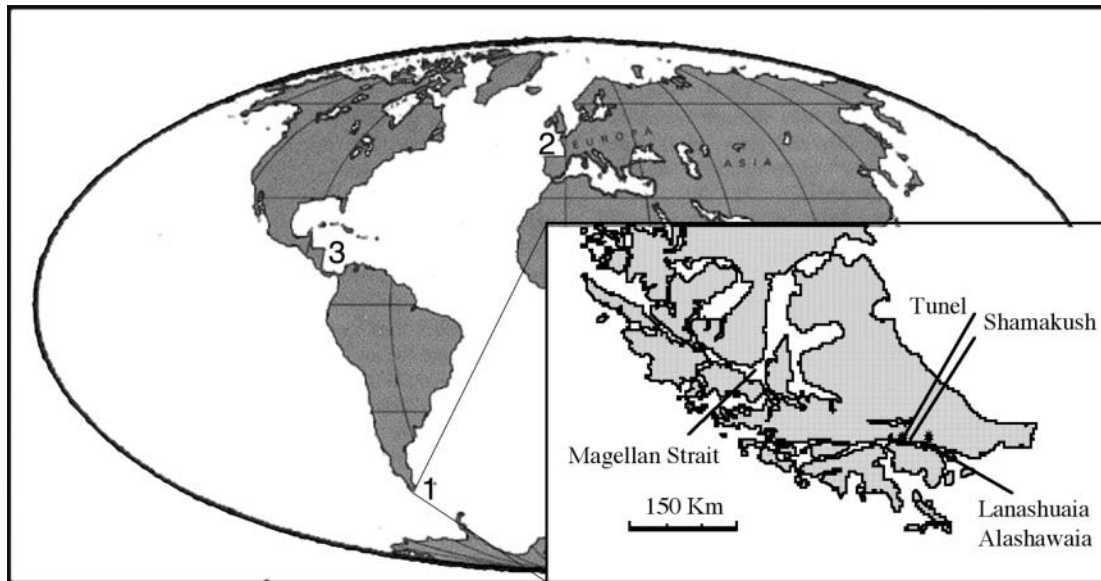


Fig. 1. Map of the geographical location of the three cases studied: (1) Tierra del Fuego, (2) Cantabria, and (3) Caribbean. Inset: detail of the excavated sites on the northern side of Beagle Channel.

have been the object of archaeological studies since 1932 (Bird 1938, 1988). The archipelago was certainly colonised by pedestrian hunters before 9700 cal BC prior to the flooding of the Magellan Strait, and then again after 5750 cal BC by groups of people who exploited land and littoral resources simultaneously. However, from at least 5150 cal BC onwards settlers on the southern coast were exploiting marine resources and must already have had some form of marine transport, as they would have had to cross a series of channels to reach sites discovered on the islands of Magellan and Navarino (dated to around the year 5100 cal BC) (Legoupil 1994; Orquera and Piana 1999; San Román et al. 2002).

Before 4400 cal BC forest vegetation of *Nothofagus* sp. (South American Beech) similar to that which exists today had spread along the coastline of the Beagle Channel. The average temperature of the water of the Channel has not varied by more than 2°C between the Climatic Optimum (between 4900 and 3200 cal BC) and short cold spells (around 1800 cal BC and the Little Ice Age of modern times) (Obelie et al. 1999). Despite minor changes in the environment, there was general stability in the nature of resources and their availability. Resources are distributed fairly homogeneously in the territory, and although they undergo slight variations over the course of a year (e.g., upward seasonal mobility of guanacos, entry of fish into the channels and breeding of birds and pinnipeds in the summer) there are no periods of seasonal shortage that would require significant migrations of people to access resources. Our general point is that any overexploitation and depletion of local resources such as molluscs, fish, birds and firewood (Piqué 1999) could be

solved by moving residence to a not-too-distant place with similar resources and/or by the dispersal of social units (which were highly mobile due to the use of canoes). Overall, these societies lived in a relatively stable environment throughout the chronological sequence considered here.

#### Excavated Sites

It has been possible to chart the settlement sequence of the region (Orquera and Piana 1999) from extensive excavation at nine sites, information from extensive survey, dates from 100 sites, and the isotopic profile of paleotemperatures (Vila et al. 1998; Estévez et al. 2001). This shellfish gathering, fishing and hunting society has been variously described as an adaptive cultural tradition (Piana 1984), a successful and sustained adaptation to a coastal area, or as a successful adaptation to an adverse environment (Orquera and Piana 1999). The largest input of calories came from the exploitation of marine mammals (hunting of pinnipeds and, occasionally, scavenging stranded whales), although the greatest effort and contribution to day-to-day subsistence was through shellfish gathering and fishing (Estévez and Martínez 1998; Estévez and Vila 1995). This diet was complemented with the hunting of guanaco (*Lama guanicoe*), sea otter, birds (especially seabirds such as cormorants and penguins), and the gathering of crustaceans as well as some fruits and mushrooms.

If we consider the tool set used, we may postulate a form of specialisation in the exploitation of marine resources. As evidence for this, we highlight the invest-

ment of labour necessary for the construction of bark canoes and their accessories, as well as in the tools needed to obtain marine resources from canoes, such as harpoons and polished weights. All of these reflect the importance of these food sources. This pattern of littoral specialisation has been described (Orquera and Piana 1999) as a forager system (*sensu* Binford 1980) incorporating a certain degree of flexibility and some collector features such as the ethnographically described hunting of guanacos by teams of men. But despite the overall stability observed in strategies for the exploitation of resources some changes did occur. These changes were virtually independent of changes in the environment and there is no real correlation between changes in technology and in the resources exploited.

### *Changes over Time*

The oldest known settlement on the north coast of the Beagle Channel is the lower level of the Tunel I site, which is dated at between 5850 and 5600 cal BC. It reveals a short atypical episode of occupation during which intensive exploitation of littoral resources is not evident. A short time later, an occupation level at the Imiwaia site (between 4800 and 4300 cal BC) and a later level at the Tunel I site (5150 cal BC) yielded artefacts related to the exploitation of littoral resources with clear signs of intensive fishing and the exploitation of molluscs present. Despite environmental stability and a general continuity in strategies of exploitation of marine resources over five millennia of occupation, one observes changes in the tools set that reveal processes of readjustment and a series of tensions in the technological and social system. Between 5150 and 4700 cal BC the first polished fishing weights appear, although polishing has been documented dating from the first occupation of Tunel I.

A new and important change is documented at the Lancha Packewaia site in the levels that correspond to 2500 cal BC. Here, a series of crudely made bifacial points and non-local raw material characterize the production of tools. Harpoons, however, continue to have the same shape as at older sites, though no decorated specimens like those seen earlier have been discovered. Finally, another important change takes place around 900 cal BC at the Tunel I site. In the fourth component there appear what can be interpreted as the first arrow points. With this technological addition almost entire the tool set documented ethnographically was present. In later periods, harpoons were simple in shape and carved decoration disappeared from bone objects.

With the arrival of Europeans in the seventeenth and eighteenth centuries, exogenous raw materials start to be used. Metal and glass substitute for autochthonous raw materials (stone points, bone awls, and knife blades made from mollusc shells). This shift has been documented at the Lanashuaia and Tunel VII sites. The adoption of European materials was sudden and surprising. In-

igenous people were very quick to appreciate the superior qualities of these new materials in tasks that had formerly been done inefficiently by local materials, which were less effective, less durable, more likely to break in use, or, in the case of flaked tools such as bifacial arrow points, more difficult to manufacture due to the unpredictable fracturing patterns of the material.

On the other hand, it is very likely that an ideological component would also have influenced decisions concerning raw material use. The new materials were not only more useful, but foreign. Possession must have distinguished the owner, as the accessibility of exogenous materials was restricted. The new materials were immediately incorporated into systems of exchange and social interaction. It is interesting to note how they were used to process larger animals that were distributed amongst various social units. It is possible that the added value of exotic materials acted as an indicator of the latent social inequalities between the two sexes within Yamana society (Vila and Ruiz 2001). Changes in tools may also have led to changes in the kind of objects being produced. In this respect, it would be useful to investigate whether the replacement of bark canoes by wooden plank or tree trunk canoes and the construction of conical huts to replace hemispherical huts made from branches was related to the introduction of European metal axes. The same could be said for ethnographic period harpoons, which are much bigger than any that have been unearthed archaeologically, and of the presence among northern canoeists of double-toothed harpoons that require more effort to produce (which have yet to be recovered in pre-contact archaeological sites).

### *Discussion*

If the same tool set as that of Fuegian canoe peoples were found in any other archaeological complex, in all probability it would lead to the conclusion that such a society was specialised in the exploitation of marine resources. Variations in the resources exploited in different areas could be seen as due to changes brought about by climatic oscillations. However, careful analysis of resource management systems over the period of a century at Tunel VII and Lanashuaia, sites which date from the ethnographic period, show that fine adjustments were made to conditions dictated by the ecological microdiversity, and that there was an opportunistic attitude in the utilisation of what was available at specific times and places (Estévez et al. 2001). At the Tunel VII site, ten consecutive occupations in the same spot would seem to indicate that it is more accurate to call this strategy “non-specialised specialisation”. Each occupation reveals differences in the kind of birds hunted and fish species caught. We can therefore state that, over a short period of time, the people adopted a wide variety of strategies to adjust to small environmental variations in space and time. In short, within a general orientation towards the hunting of



pinnipeds with harpoons, fishing from canoes, coastal gathering of molluscs, and the hunting with bow and arrow of guanacos in winter by small teams of men, they otherwise took advantage of whatever was available. Tools were also opportunistically used. Although the most suitable weapon for the hunting of pinnipeds was the harpoon, they were also hunted from land with bow and arrow, probably as a result of casual and likely relatively frequent encounters.

Even the most important social happening was the result of chance (at least in the ethnographic period). Stranded whales provided an opportunity for several autonomous family units to meet and these occasions brought into play the few strategies used to preserve food (e.g., whale meat deposited in peat bogs). These activities also produced the most intense periods of social interaction. To sum up, there is no rigid barrier between logistical strategies (putting to sea in canoes to harpoon pinnipeds, raids on the nesting sites of birds, or expeditions to hunt guanacos in small teams) and opportunistic strategies. This kind of specialisation does not imply inflexible strategies.

### *The End of the System*

The most interesting question concerns the continuity and maintenance of the system. It has been said that the constant flow of biomass from the Antarctic confluence and the inaccessibility of the breeding grounds of pinnipeds created a supply of resources that was barely affected by human exploitation (Schiavini 1993). However, population density – there was a population of between 2500 and 3000 people for the littoral area south of the Beagle Channel at the time of contact with Europeans – was high compared with other hunter-gatherer societies. An approximate calculation suggests that this population had stabilised near the maximum extractive capacity of the Yamana economic and social organisation. A population growth model that begins 6000 years ago and ends in a final total population of 3000 people requires a growth rate way below normal human capacity. This phenomenon can best be explained by the existence of a strict control on reproduction. It is very difficult, although it is not impossible, to demonstrate archaeologically that imbalances between biological and social reproduction were transmitted to production strategies. The changes observed in technological development that were mainly designed to reduce costs, including the styling of harpoons or increasing the range and effectiveness of weapons (e.g., arrow points replace the larger points of spears and javelins, metals and glass replace stone and bone raw materials very quickly), may have been stimulated by these contradictions.

The technological changes were a way to resolve the contradiction between the growing social needs of food and the acquisition of subsistence by reducing the cost of labour invested in food procuring in a context where the

renewal or replacement of natural resources is biologically limited. Processes of population control such as periods of death from starvation, stress or even through infanticide are difficult to detect, although infants have been found buried in shell middens at a significant number of sites between 50 cal BC and 400 cal BC. Changes in the internal arrangement of habitation units in the Beagle area have been documented throughout the sequence (Orquera and Piana 1999). Ideology must also have undergone changes in order to control population growth. Although we still do not have enough data for the southern area before the ethnographic period, in the northernmost area of Magellan (which was osmotically linked to the southern area as shown by sites excavated to the north of the Strait of Magellan [Legoupil 1985-1986]) a number of significant changes in funerary practices have been identified (Prieto 1984). It must have turned out to be more economical to establish an asymmetrical system with reproductive control over women like the one that has been documented ethnographically, instead of developing new means of production and work organisation that would have permitted a substantial increase in the extractive capacity.

These social controls and restrictions on reproduction (Vila and Ruiz 2001) were maintained despite the diseases introduced by European visitors from the seventeenth century onwards. The historic period overkill of marine animals, despite their huge original numbers and their enormous regenerative capacity, happened very quickly due to the mass killings carried out by European and American sealers who were able to reach the breeding places that were normally inaccessible to the indigenous peoples. These changes were too great and happened too fast. They truncated the balance that had been achieved over a long time span without allowing enough time for the established reproductive system to adjust. We can conclude that technological changes (the adoption of new techniques and materials) were gradual and constant over the long term, but were not necessarily accompanied by structural changes *per se* in the society, whose capacity for continuity was frustrated by a conservative strategy of social reproduction. The Yamana society as such disappeared, like so many others of its type, when it came into contact with another whose strategy of social reproduction was diametrically opposed. The incorporation of different technology implied neither demographic intensification nor development, but quite the opposite.

In conclusion the evolutionary pattern in our first case study involved limiting population growth (despite maintaining a relatively high population density) and adopting some minor technological developments in order to avoid the high cost of a big social and technological jump to a more complex society.

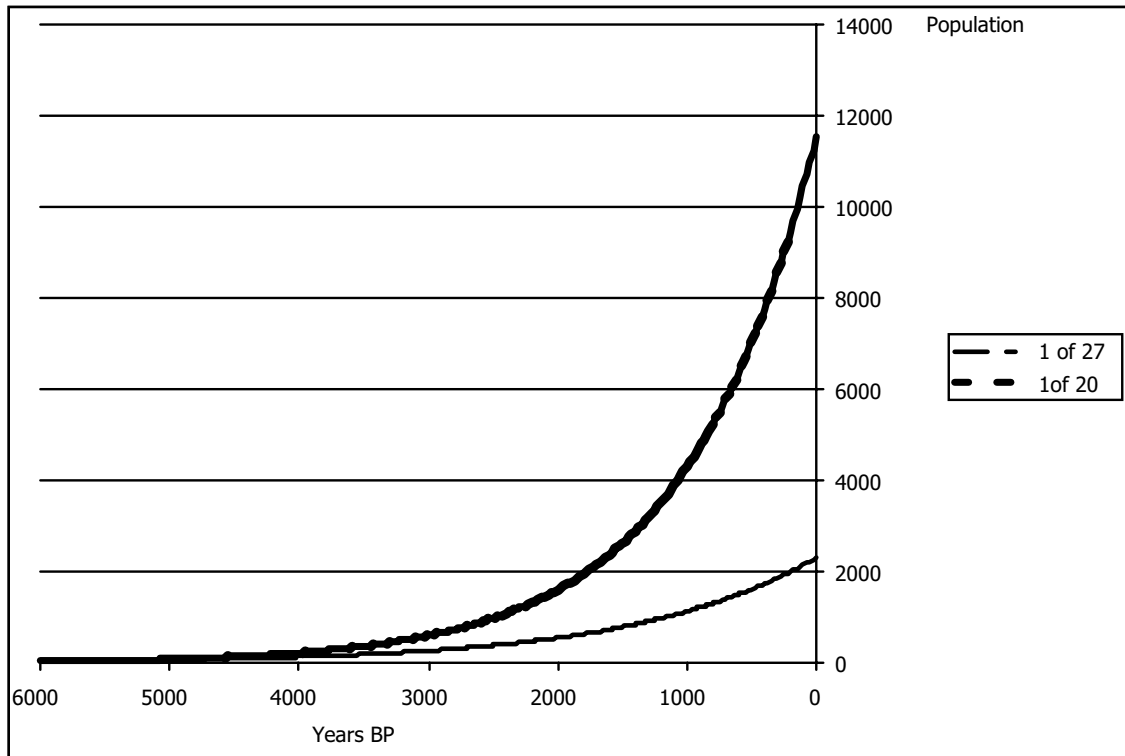


Fig. 2. Population growth simulation curves over 6000 years starting with a group of 30 people. Lower line depicts a rate of only one woman in 27 producing more than 3 fertile descendants, while upper growth line reflects one in 15. Both produce final populations well below human carrying capacity.

### The Cantabrian Coast: A Long Sequence of Changing Hunter-Gatherer Societies

The Cantabrian coast is situated in the north of the Iberian Peninsula and lies on an east-west axis at a latitude of 42° north (Fig. 1). Due to its position, it nowadays enjoys a mild oceanic climate with heavy annual precipitation and moderate variations in temperature. Its relief is created by the existence of the Cantabrian Mountains running east to west and rising to heights of over 2500 m in the western half of the range. The proximity of this mountain range to the sea creates a wide variety of ecological niches within 30 km of the coast. This diversity is magnified by the differences among the major valleys that generally run from south to north. The steep gradient of the mountains resulted in a marine transgression after the last ice age that flooded only a relatively small area and, in most cases, the Pleistocene coastline was less than 10 km from where it stands today.

There are extensive archaeological remains throughout the Cantabrian region that date from the Middle Pleistocene and document a relatively late process of Neolithization after 4500 cal BC. Their analysis allows us to identify transformation processes within local hunter-gatherer communities over a long period of time. For this reason the region provides an excellent opportunity to investigate the subsistence strategies of

the last foragers, the changes they went through compared with other groups at the end of the Pleistocene, and, finally, how their existence ended in the context of the progressive Neolithization of Atlantic coastal areas of Europe. Other researchers who have studied these issues in the area have sought an explanation for change in causes unrelated to the social and economic organisation of these groups. Ecological factors have played a central role in these explanations, both on a macroclimatic level (Altuna 1990, 1995; Arias 1991, 1992; Clark 1983a; Clark and Straus 1983; Quesada 1998; Straus 1992, 1995) and from a microgeographic perspective centred on local resource patches (Bailey 1973, 1978, 1983; Clark 1983b, 1995; Clark and Straus 1983). It is true that the foragers of the Mesolithic lived in progressively milder climatic conditions with fewer climatic fluctuations than were characteristic of the end of the classical Würm IV glacial substage (Hoyos 1995; Leroi-Gourhan and Renault-Miskovsky 1977). Milder conditions were finally established around 8000 cal BC. As an alternative or complementary factor, demographic growth has also been used to explain the progressive diversification of faunal exploitation at the end of the Pleistocene, changes in settlement patterns, and the technological modifications of the Mesolithic (Aura et al. 1998; Bailey 1983; Clark and Yi 1983; González Morales 1982, 1992; González

Sáinz 1989, 1992; González Sainz and González Morales 1986; Straus 1981).

### *Changes over Time*

Though the economies of the inhabitants of the region did change at the end of the Pleistocene, the archaeological record reveals that the pace of these changes increased after 13,000 cal BC. In the late phases of the Magdalenian Period, specialised hunting systems that had been gradually developing during a large part of the Upper Palaeolithic slowly began to broaden. In the centuries that followed, these changes spread to other spheres of social activity, such as the production of artefacts, the exploitation of plants, settlement organization, as well as symbolic and ritual activities. This suite of variations has justified these groups being referred to as Epi-Palaeolithic or Mesolithic, depending on the author, and they have often been perceived as decadent compared with the “high hunter cultures” of the Upper Palaeolithic. But what were the underlying parameters of these faster changes? Rather than list the individual features gleaned from archaeological data, we will describe the general factors that, in our opinion, generated these evolutionary changes.

Throughout the Upper Palaeolithic in Europe, the production of food was increasingly oriented towards the hunting of medium-sized herbivores (artiodactyls and, to a lesser degree, *Equidae*) and restricted to one or two primary species. In the north of the Iberian Peninsula this process was complete at about the time of the glacial maximum (coinciding with the Solutrean and Late Magdalenian periods). This period was the highpoint of a trend that starts at the beginning of the Upper Palaeolithic and developed throughout the different climatic phases of the last stadial (the Würm IV stage). The main species hunted was the red deer (*Cervus elaphus*) and to a lesser degree the mountain goat (*Capra pyrenaica*). Although there is an east-west gradient in the relative abundance of deer, evidence suggests that variation in the representation of ungulate species in different faunal assemblages is mainly the result of the location of each settlement (Altuna 1990, 1995, González Morales 1982, González Sainz 1989, 1992, among others). Consequently, at sites situated in areas where the terrain is steep there is greater exploitation of goats, whereas at sites located in areas of much less abrupt terrain, the predominant species was red deer. However, in some settlements one observes an interesting alternation between samples dominated by goat or deer that cannot be explained by environmental factors. The cause should perhaps be sought in the different biotopes that were exploited during different episodes of occupation.

Whatever the explanation may be, the pattern reaffirms the existence of specialised hunting systems and the specific function of settlements within them. This could indicate a logistical strategy of territorial occupation

(*sensu* Binford 1980). From about 13,000 cal BC onwards, archaeofaunal remains reveal a progressive increase in the presence of other species of mammals, birds, fish and molluscs (which, although they also appear earlier, do so in much smaller numbers). This process has commonly been interpreted as the regional manifestation of the “Broad Spectrum Revolution” that characterised the majority of European Mesolithic societies in Europe (Castaños 1992; Clark and Yi 1983; González Sainz 1992; Straus 1992). Principally in the western Cantabrian region after 8900–9000 cal BC one observes large accumulations of shell at sites both in previously occupied and new settlements. Many caves and rockshelters were filled with shell middens several meters high.

At the same time, the relative uniformity of the technological complexes of the region was broken. In the eastern half one observes a progressive trend towards the microlithization of the preceding Azilian industries, which was based initially on a large number of artefacts on microblades. After 11,500 cal BC, the industry centred on obtaining geometric microliths from local sources of flint, as had occurred in the preceding phase. Initially, this process is also observed in the western half of the region, but ends suddenly around 8900 cal BC. The Mesolithic industry in the west is characterised by small groups of artefacts made in a very expedient fashion on barely retouched cores and flakes. Quartzite, which was found locally, was the main raw material used. In both areas, bone and antler tools decrease appreciably, until they almost disappear in the west.

Based on the remains of medium and large mammals present at sites of this period, most Mesolithic scholars maintain that the foragers of the Cantabrian coast during the Holocene progressively diversified their subsistence in order to take maximum advantage of the wide variety of foods available in the thermophile forests. However, a more detailed explanation is necessary here. Study of the level of polarisation of these remains shows that, broadly speaking, there was indeed a decrease in the dominance of a single species of hunted mammal (Gassiot 2000). However, this relative widening of the spectrum is not linear throughout the region. Fig. 4 shows the average of dominance index (Estévez 1979) for species of ungulates from sites in both segments of the Cantabrian region between 18,500 cal BC and 4500 cal BC. In brief, an analysis of this data reveals that taking into account only ungulate mammals in the quantitative analyses (which is the usual procedure), there is diversification of subsistence, but on a very small scale. In all the periods, the NISP of the dominant species accounts for more than 50% of the total NISP for all species. This pattern produces positive values for the dominance indices.

The trend to decreased polarisation is more marked in the eastern region where the lowest levels of specialisation are apparent at the end of the Pleistocene and during the Holocene. In the western half, the process is not continuous. During the period between 11,500 cal BC and

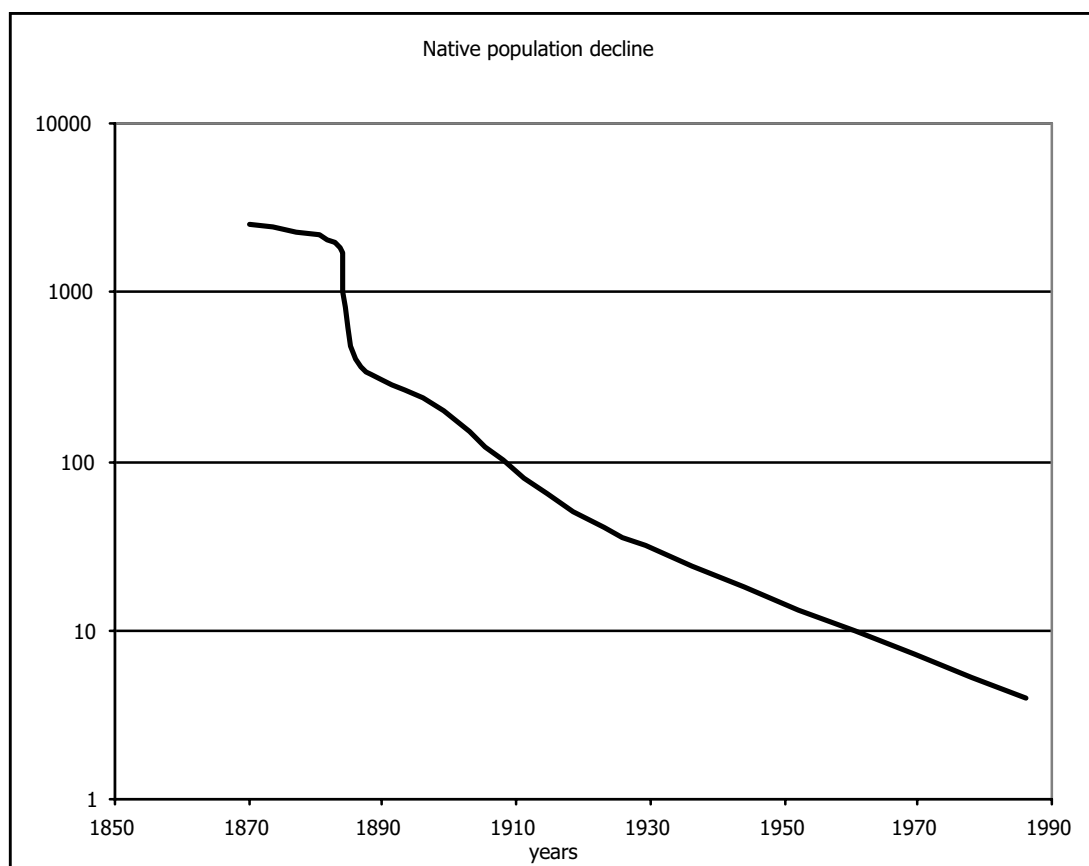


Fig. 3. Native population decline in Tierra del Fuego following the impact of European seal hunters on local marine resources.

8900 cal BC (the classic Azilian Period), when a wide variety of archaeofauna existed, one observes a clear polarisation in the hunting of medium-sized mammals mainly in favour of deer. The decrease of this index during the subsequent Mesolithic period is based, moreover, on a small number of samples from sites with a very low NISP.

The dominance and specialisation indices for sites in the western half of the Cantabrian coast are higher than those for the eastern half in all the periods. A paired t-test comparing the sequence of dominance indices from western and eastern Cantabrian sites shows a significant difference between them (hypothesized difference = 0,  $DF = 4$ ,  $p = 0.1330$ ). However, the difference between the two areas clearly increases in later periods. This is an interesting observation that is related to a break in general technological patterns for the whole region and the appearance of shell middens mainly in the west. This is also to be expected in a context of diversified subsistence and greater orientation of production towards the exploitation of local resources. Returning to the diversification in hunting, a number of authors have

linked this to processes of economic intensification, in which investment in labour is increased in order to obtain greater outputs by means of the exploitation of less profitable resources. In accordance with this line of reasoning, the pressure that intensive hunting can put on a given species may affect its capacity to reproduce and thereby reduce its density. Regardless of whether this did in fact happen in the Upper Palaeolithic or not, any increase in the degree of specialisation produces a change in the relationship between human activity and the animal species in question, which may manifest itself in the way that the latter is exploited. At first it may result in greater exploitation of sub-adult individuals and, second, in the increased consumption of parts of the anatomy that confer much less benefit. In the long term, both factors affect the general efficiency of hunting a particular species and encourage the search for alternatives. Davidson's studies in the east of the Peninsula (1989) also suggest that continuous pressure through selective hunting may have affected the sexual dimorphism of goats and deer in different ways.

Given the high level of fragmentation that the faunal



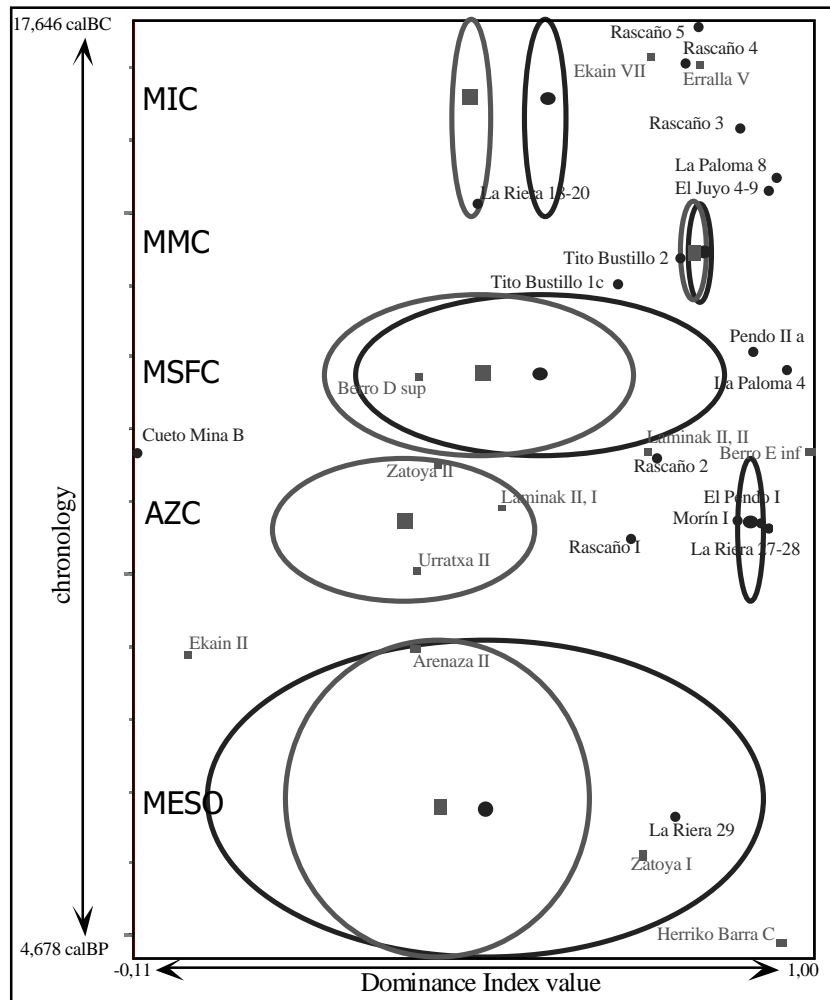


Fig. 4. Trends in dominance indices for the Cantabrian Coast area between the early Magdalenian and Mesolithic: MIC = Early Magdalenian; MMC = Middle Magdalenian; MSFC = Late Magdalenian; AZC = Azilian; MESO = Mesolithic. Western Cantabria = dark gray line and squares; Eastern Cantabria = light gray lines and circles. Ovals indicate 1 standard deviation around the mean for each period and zone. Individual sites with extreme values are also included.

remains of this period display (another potential indicator of an increase in the exploitation of the product of the hunt), calculations of the age of hunted animals are not very reliable. Nevertheless, it is possible to examine the second implication – that of greater exploitation of low utility animal portions. A comparison of the anatomical representation of deer remains between archaeological and taphonomic samples has revealed a number of interesting facts (Gassiot 2000).

1. There is an increase in the transport of the axial skeleton, which has a lower meat value, to archaeological sites. This increased presence of axial skeletons is coherent with a greater exploitation of the carcasses and cannot in this case be explained by taphonomic factors related to different methods of preservation or the greater identifiability of the

appendicular bones (as the increased fracturing affects all parts of the skeleton).

2. In general, the exploitation of the carcasses is greater at sites in the western half, where the degree of polarisation is also greater.
3. Diversity within each period is very high. The highest regularities are observed within each site, where the indices of exploitation during each occupation display relatively similar values. It would appear that the location of the settlement in relation to the hunting grounds was the most decisive factor influencing the transport of animal parts to the place of consumption. Having said that, sites with long sequences tend to have a progressively greater presence of parts of the axial skeleton. For the exploitation of mountain goat, an increase in the

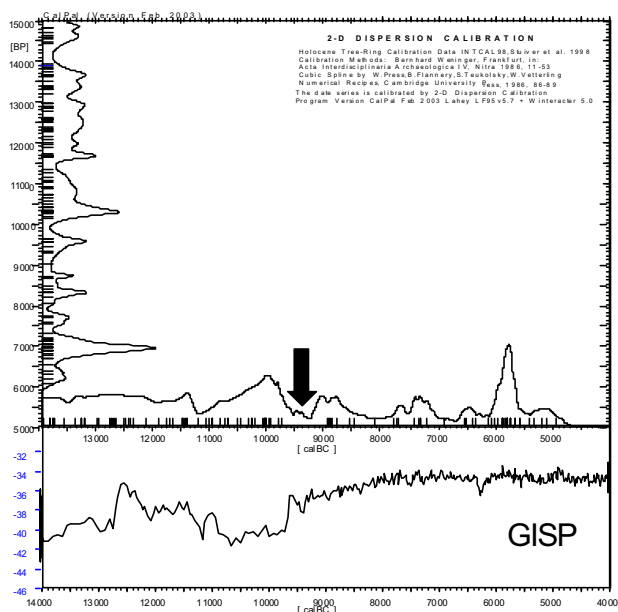


Fig. 5. Cumulative probability curve of the reliable calibrated  $^{14}\text{C}$  dates for Cantabrian sites generated with CALPAL 2003. The arrow marks a gap of more than 500 years (just before 9000 cal BC) between sites classified as Azilian on the left and those of the later Asturian and Mesolithic on the right.

ratio of fore limbs to hind limbs seems to prompt a similar explanation (Gassiot 2000), though we will not deal with this issue here.

In parallel with the signs of economic diversification and intensification of exploitation of mammals, there is an increase in the consumption of birds, fish, and molluscs of terrestrial and, later, marine origin. However, these fauna have received little attention from researchers prior to the 1990s and there is little solid quantitative data available to characterize this trend. Unfortunately, recovery methods have without a doubt caused the underrepresentation of ichthyofauna. Nevertheless, the appearance of shell middens may also be related to general changes in subsistence. All the shell middens of the region, without exception, date to after 10,500 cal BC. This fact has often been explained with reference to the postglacial marine transgression, which would have flooded littoral Palaeolithic settlements. However, the fact that multiple shell middens of land snails appear in the western Pyrenean area during the Holocene lends weight to the idea that this phenomenon is related to the economic changes of the period. In short, these data seem to indicate that the intensive exploitation of marine and land molluscs was one more component of a process of diversification of subsistence and increased utilisation of the resources of the local environment by the last foragers

of the Cantabrian coast. This process will become much more obvious when quantitative data of all the different types of fauna that were consumed can be included in the analysis. Likewise, improvements in excavation and recovery of archaeological remains are allowing researchers to obtain data that confirm an increase in the consumption of plant foods during the Holocene (González Morales 1995).

### Discussion

The hypothesis of continuity between the Upper Palaeolithic and Mesolithic hunter-gatherers on the Cantabrian coast has made possible an evaluation of the economic changes that took place in evolutionary terms. This has fuelled numerous studies of the last foragers of the Atlantic coast of Europe. However, in the coming years researchers need to solve a significant problem that currently raises doubts about models of continuous development. The calibration of 245 absolute dates available from 19,000 cal BC (the Early Magdalenian) through Neolithization (4500 cal BC) reveals a hiatus of around 900 years between the earliest chronological limit of the Mesolithic and the latest phase of the Azilian Period (Gassiot 2000). Therefore, between the dates of the most recent Azilian levels and the oldest Mesolithic dates there is an unexplained gap between 9750 to 9000 cal BC, suggesting cultural discontinuity. Another possible explanation, and in this case a continuity hypothesis could still hold true, is that there may be a problem in the calibration curve for this period. In the coming years, both an increase in the number of calibrated dates and future research into the translation of radiometric dates into calendar dates for the end of the Pleistocene should shed some light on this problem.

### Concluding remarks

The archaeological sequence of the Cantabrian coast illustrates a number of interesting aspects for the study of hunter-gatherer societies. First, both the specialised hunting process and the later "Broad Spectrum Revolution" developed during changing environmental conditions characterised initially by the intense and fast fluctuations of the Late Glacial Maximum and later by the climatic oscillations of the Last Termination. This effectively illustrates that we should not attempt to understand the economy of these groups as dictated linearly by what the environment had to offer. An additional observation makes this point clear. Despite the paleoclimatic differences of the Last Termination between the north of the Iberian Peninsula, southwest France, the eastern Pyrenees, and the Mediterranean area, the processes of social change followed parallel courses with a similar chronology. Second, the process of economic diversification of the Mesolithic communities should be understood in relation to previous specialised hunting

systems and as a way to resolve their internal contradictions. The broadening of ecological niches typical of the end of Upper Palaeolithic and the Mesolithic in many European regions, despite being difficult to correlate with more extensive changes in the conditions of the environment, do match local ecological conditions. An example of this is the kind of animals and plant foods that were consumed. However, within them lie causalities that stem from tensions between the need to increase economic territories due to hunting polarisation and the social and labour costs that this implies. Finally, on the Cantabrian coast, the exploitation of littoral fauna is linked with a very late process of Neolithization that occurred in the second half of the 5th millennium cal BC. This phenomenon has also been observed in other areas where Mesolithic communities exploited a wide range of littoral and marine animals, such as on the Jutland Peninsula or the central coast of Portugal. In both cases, as on the Cantabrian coast, when the earliest forms of domestication are finally introduced they do not represent a dramatic break with former lifestyles, nor do they show any evidence of previous technical or social complexity.

### **The Caribbean Case: Hunter Gatherers on the Edge**

Despite a general shortage of archaeological data, the prehistory of the Western Caribbean provides an interesting comparative reference point for the study of the last forager societies living in coastal environments in boreal latitudes. Their environmental conditions, which were generally dominated by a humid tropical climate, offer considerable diversity. These conditions are due as much to latitudinal variation among the different areas of the region as to the microecological diversity of the majority of its coastal areas. The succession of continental tropical rainforest, open savannah, swampland, lagoons, exterior coasts and cays combines with the markedly seasonal nature of the precipitation to create extensive biodiversity. The pollen columns analyzed for the highlands of Central Panama and the area surrounding Bluefields Bay in Nicaragua display a broad stability in climatic conditions from the beginning of the Holocene (Piperno et al. 1990; Urquhart 1997). In the littoral areas the greatest environmental changes are related with the marine transgressions and regressions of the Middle Holocene and with the processes of silting up of coastal lagoons and the formation of new sandbars.

Very little is known about the pre-Neolithic settlement of the area during the Paleoindian and Archaic periods (Keegan 1994; MacNeish and Nelken-Terner 1983; Veloz 1991). Nevertheless, the study of several sites and specific areas provided some interesting results (McGimsey 1956; Ranere and Cooke 1995; Willey and McGimsey 1954) and revealed that the scarcity of data is simply the product of the small quantity of archaeological research that has

been carried out. The analysis we present here is the product of our research in Bluefields Bay and Pearl Lagoon in Nicaragua where, since 1998, we have located over 80 shell middens. Research in this area has enabled us to compile a sequence of absolute dates between the present and 1500 cal BC (Gassiot and Palomar 2001). Data from the excavation of shell midden 4 at the Karoline site (350 cal BC–350 cal AD) offers an in-depth view of the agricultural societies of the area that can be contrasted with the parameters that define the forager communities of the Archaic. This view of the lifestyles of the last foragers of the southwestern Caribbean and its comparison with those communities that followed offer clues that help us to understand how the last hunter-gatherer-fisher economies functioned and the general parameters of their evolution.

### ***Caribbean Forager Settlement***

Diverse evidence suggests that settlement of the tropical rainforest of Central America took place at the end of the Pleistocene. This contradicts the thesis (Bailey et al. 1989) regarding the inability of hunter-gatherer groups to exploit this kind of environment. Bifacial projectile points with a morphology similar to Clovis, Fishtail, and others, as well as evidence of their manufacture (Acuña 1983; Brown 1980; Coe 1960; Snarskis 1977), have been recovered as surface finds from different parts of the isthmus. In the central mountain range of Panama a small number of levels of occupation have been dated at around 10,500 cal BC (Ranere and Cooke 1995). The number of sites of this age increases notably in the centre of Mexico where there has been much more archaeological research (MacNeish and Nelken-Telner 1983). Evidence from both Panama and Mexico reveals that these groups based their subsistence on the hunting of a variety of land mammals using technologies similar to large mammals hunting groups in the southwest United States. The exploitation of deer (and occasionally of mammoths in Mexico) was supplemented by small mammals and presumably by plant foods. As far as the Atlantic lowlands of Central America are concerned, we only have information from sites excavated in Belize that contained a bifacial point industry (Lowe-ha Phase). Unfortunately, there are no absolute dates available.

There is more evidence for the presence of foragers in the Central American lowlands during the Holocene. The most revealing sites are once again found in Panama, such as the primarily shell midden sites of the central Pacific Coast around Parita Bay. The best-known of them, Cerro Mangote (McGimsey 1956), has been dated to around 5700 cal BC and consists of a mound of shells over 50 m long containing many burials in structured groups. This gives credence to the possibility that the middens were the product of fairly stable groups that inhabited the area for relatively long periods of time. At this time subsistence was based on the varied exploitation

of marine molluscs, especially oysters and crabs, estuarine ictyofauna, land mammals such as white-tailed deer, peccary and racoon, as well as turtles and birds. The presence of milling stones and grinders among the stone artefacts also indicates the processing of wild plants. The stone industry was very expedient and manufactured on local raw materials. The first use of pottery in the area takes place in a very similar context with the complete absence of evidence for the exploitation of domestic plants, and where subsistence and technology display characteristics of the preceding period at sites such as Monagrillo (Willey and McGimsey 1954), dated between 3000 and 300 cal BC (Ranere and Hansell 1978). The combination of an expedient industry and a diverse exploitation of the environment are features that are also present at the Archaic sites of the central highlands of Panama.

In the lowlands of the Caribbean, the sequence developed for Belize illustrates a similar process (MacNeish and Nelken-Telner 1983). In the technological sphere, during the Holocene the lithic industry progressively incorporates a considerable variety of morphotechnical types at the same time as, in general terms, flaking processes are being simplified. The presence of milling stones and stone bowls after 5900–5000 cal BC suggests the processing of plant foods, which increases throughout the rest of the sequence. Moreover, from this period onwards there is evidence of the exploitation of littoral and marine fauna, the importance of which increases in later phases. In Nicaragua, the 6 m shell midden excavated at Monkey Point, dated to between 6100 and 3700 BP (information supplied by J. Espinosa 1998), also reveals recurrent settlement in this place by forager groups. Among the varied fauna that has been recovered are the remains of deepwater species such as shark, as well as land mammals. Numerous milling stones form part of the stone industry at this site. Turning to the Caribbean islands, a number of large shell middens like that at Banwari Tracé on the island of Trinidad (Velo 1991) also suggests the presence of fairly stable settlements with a similar chronology to that of the mainland coast. Even if these communities were not of a sedentary nature, they regularly inhabited the same places and generated large quantities of waste.

#### ***Southwestern Caribbean Farmer Settlement***

The exploitation of marine and littoral environments continued throughout virtually all of subsequent prehistory. On the Atlantic coast of Nicaragua there is a sequence of shell middens that runs from 1500 cal BC to 1000 cal AD. This sequence is notable for its geographical and temporal variability both in terms of the fauna that was consumed, the characteristics of the shell middens, and the position they occupy within the economic practices of these groups (Gassiot 2002b). Shell midden Number 4 from the Karoline site stands out in this respect.

It has been excavated recently (Clemente and Gassiot 2002) and has revealed an area of domestic activity with abundant remains of ictyofauna, land mammals, birds and fruits as well as marine and estuarine molluscs. A variety of wild fruits and seeds were also part of the diet. It is likely that the fragments of calcified wood are the remains of a variety of yucca, which would confirm the existence of some form of agriculture. The nearby Rocky Point midden has revealed the hunting of manatee (*Trichechus manatus manatus*), an aquatic mammal exploited in many parts of the Caribbean over a long period of time, including the Archaic period (McKillop 1985).

Data available for the region shows a wide and diverse exploitation of a variety of animals and biotopes during the last three millennia of prehistory, mainly by groups that practised some form of agriculture. Such is the case of the lowlands of Belize where at Preclassic and later sites it is common to find extremely diverse faunal groups with a notable presence of aquatic taxa (mainly molluscs and fish) (Vail 1988).

#### ***Discussion***

Forager settlement of the Central American side of the Caribbean is poorly documented in comparison with the other two cases discussed in this paper. However, as in Tierra del Fuego and the Cantabrian Coast, it is possible to see processes of change in the hunter-gatherer societies despite a backdrop of general environmental stability. Transformations took place in terms of their technological industry, with the simplification of many manufacturing processes, and in terms of the reorientation of their subsistence towards the intensive but wide-ranging exploitation of the local biomass. This diversification in the acquisition of food contrasts with a previously more restricted hunting spectrum that was centred on mammals in the last part of the Pleistocene. The sites in Belize and Panama illustrate how this transformation was slow but constant. For the last forager communities this economic organisation combined with increased stability of settlement that either adopted a year-round pattern or recurred regularly at the same places based on seasonal cycles. The development of agriculture did not represent a major departure from preceding lifestyles as was the case in the Archaic communities of Central Mexico. Moreover, the varied exploitation of the environment continued to take place even in very different social contexts, such as the coast of Belize during the Classical Mayan Period.

#### ***Final Discussion***

The case studies presented here provide examples of last forager societies living in littoral environments in three parts of the planet with very different climates. All three developed an intensive exploitation of a wide variety of



local resources that was compatible with a notable level of opportunism and simultaneously with a number of highly specialised and sophisticated production methods (such as the bow and arrow, canoes and harpoons). In at least two of these cases this way of life was the result of the progressive transformation of preceding forms based on a higher level of hunting polarisation. Likewise, all three developed stone technology that was largely based on the reduction of the labour investment in tool production through the use of local rocks and the simplification of the processes of manufacture. The exception of the Fuegian bifacial points with flat retouch is perhaps simply incidental, as is suggested by their rapid substitution when Europeans introduced an alternative material that was easier to work. Moreover, this form of lithic manufacture was rapidly abandoned; ethnographic reports state that it had ceased to be practiced by the end of the nineteenth century.

These examples contrast sharply with those archaeological contexts where hunter-gatherers were oriented towards the specialised exploitation of ungulates, such as in the preceding Magdalenian and Paleoindian periods or with contemporary groups such as pedestrian hunters of continental Patagonia and the north of Tierra del Fuego in relation to the Fuegian canoeists. In all three cases we detect certain shared parameters that underlie a number of divergent practices, which are the product of the specific geographical and historical contexts of each case. Most significantly, the three examples of foraging communities studied show signs of internal evolution that do not correlate with changes in their environmental conditions. The respective archaeological sequences illustrate variations in the objects exploited for subsistence in the Caribbean and Cantabria as well as technological changes in all three cases. This fact makes it difficult to suggest that the subsistence and social organisation of these groups were an adaptation to specific geographical environments. The relationship between consumption patterns within the framework of different production cycles and the configuration of available resources was, in none of the cases, a situation that was closed and fixed in time. The wide geographical spread of a number of the phenomena studied, as well as the economic and social transformations during the Mesolithic in the Cantabrian-Pyrenean area, prevent attributing these changes to the fact that these societies inhabited littoral environments.

Throughout this paper we have outlined the factors that influenced the specific changes of the last forager societies we have analysed, though more completely in Tierra del Fuego and the Cantabrian Coast where there more data are available. Some lapses in the settlement sequence (marked by a lack of  $^{14}\text{C}$  dates) or ruptures in the development sequence of tool sets suggest periods of crisis both in Cantabria and Tierra del Fuego that do not correlate with changes in the environment. In both cases, the explanation is to be found in the social conditions of these groups and the labour organisation designed to

provide each group with the means necessary for their subsistence (and for those linked with their biological and social reproduction). Again, as in Darwin's time, the isolated position of Tierra del Fuego and its island character makes this case a very useful laboratory example.

The idea that the problem is closely linked with social production or, to put it another way, that it is related to the strategies of resource and labour force management, creates a number of interesting challenges for our discipline. Although it is true that the orientation towards the exploitation of littoral resources in the three case studies did indeed impose a series of common organisational and technical facilities regardless of the diversity of environments involved, this did not influence the timing of changes or the ultimate fates of the social formations considered. It is clear that factors of place and time in relation to the resources that a given environment makes available are an aspect that must be included in our studies. To deny their importance would be tantamount to denying the very material foundations on which all social life is based. It is necessary to identify the work processes, the time needed to carry out different activities, the structure and dynamics of the output of each activity, the usefulness of the products and their relationship with possible needs, an other similar elements in order to establish wider explanatory models. Having said that, it is also necessary to explain under what social conditions any range of resources were exploited from the perspective of the range of objects that were present within the social structure of the communities.

To approach this problem it is necessary to go beyond the simplistic categories that have hitherto been established and which are often applied schematically and mechanically. The littoral-inland, foragers-collectors, or specialised-broad spectrum dualities ignore a much greater subtlety that requires very accurate analysis of variability not only in terms of space but also in terms of the comparison of development over long time scales in relation to shorter ones. To make this effort means, in short, to view history within our discipline not as a vague succession of cultures, but as the way human groups defined their lives over time. There is still much work to be done even in an area like Cantabria, where scientific archaeological studies have been carried out for over 100 years.

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